Telephony.

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Final Decision in the Berliner Patent Cause.

On January 16, 1903, there was handed down in Boston the decision of the United States Circuit Court of Appeals in the Berliner case [American Bell Telephone Company, complainant and appellant, against National Telephone Manufacturing Company et al., defendants, appellees].

The court, consisting of Judges Colt, Putnam and Aldrich, found, the opinion being written by Judge Colt, that there was no infringement.

The decision is a crushing blow to the Bell company, and is an Independent victory the effect of which will be world-wide. This is the last legal obstruction and with its removal the telephone is free. The full decision is appended.

This is an appeal from a decree of the Circuit Court dismissing a bill brought for infringement of Letters Patent No. 463,569, issued November 17, 1891, to the American Bell Telephone Company, as assignee of Emile Berliner. A caveat describing the invention was filed April 14, 1877, and the application for the patent June 4, 1877. The patent is for a battery telephone transmitter of the variable-resistance type.

A battery transmitter is one in which a battery or strong current is utilized for the transmission of speech, as distinguished from a magneto transmitter, in which only a feeble current is generated by induction. It requires a battery current to transmit speech long distances. The variable-resistance type of transmitter utilizes a battery current for the transmission of speech by varying the electrical resistance in the circuit. Variable resistance means simply variable obstruction to the passage of the current. Variable resistance changes the strength or intensity of the current, and if these changes correspond to the changes in the density of the air caused by sound-waves, we have a current whose electrical undulations or vibrations are similar in form to sonorous vibrations or sound-waves, and which will transmit speech. In a telephone transmitter variable resistance refers to the changes in resistance which take place at the contact between the two conductors or electrodes, produced by the vibrations of the diaphragm caused by the sound-waves.

The Berliner transmitter, covered by his patent in suit, utilizes a battery current for the transmission of speech by varying the electrical resistance in the circuit. The drawing from the patent shows the Berliner telephone, in which Fig. 1 is the transmitter in controversy, and Fig. 2 the receiver.

In this drawing, as appears from the specification (A) is a metal plate which vibrates when sound is uttered against it. Against this plate, and touching it, is the metallic ball (C) at the end of the screw-threaded rod (B), which is supported by the bar (d). The pressure of the ball (C) against the plate (A) can be regulated by turning the rod (B). The ball and plate are included in circuit with an electric battery, so that they form electrodes, the current passing from one of them to the other. By making the plate vibrate, the pressure at the point of contact becomes weaker or stronger as often as vibrations occur, and the strength of the current is thereby varied accordingly. By placing another instrument capable of acting as a telephone receiver, as shown in Fig. 2, in the same electric circuit, sound uttered against the plate of Fig. 1 will be reproduced by the plate of Fig. 2, for as the vibrations of the transmitter diaphragm caused by the sound will alternately weaken and strengthen the current as many times as vibrations occur, the diaphragm of the receiver will be caused by these electrical vibrations to vibrate at the same rate and measure. The latter vibrations being communicated to the surrounding air, the same kind of sound as uttered against the transmitter (Fig. 1) will be reproduced at the receiver (Fig. 2). It is not essential that the plate should be of metal. It may be of any material able to vibrate, if only at the point of contact suitable arrangement is made so that the current passes through that point. It may be of any shape or size, or other suitable vibratory medium may be used, for example, a wire. Any other metallic point, surface or wire may be substituted for the ball.

From this description in the patent we find that the Berliner transmitter consists of a battery circuit with two electrodes in constant contact. One electrode is composed of a diaphragm or plate of metal or other vibratory material, and the other electrode of a metallic ball or point. Sound uttered against the diaphragm causes it to vibrate. These vibrations vary the pressure between the electrodes at the point of contact so as to strengthen and weaken the contact, and thereby vary the electrical resistance of the circuit.

The following claims are in issue:

"1. The method of producing in a circuit electrical undulations similar in form to sound-waves by causing the sound-waves to vary the pressure between electrodes in constant contact so as to strengthen and weaken the contact and thereby increase and diminish the resistance of the circuit, substantially as described.

"2. An electric speaking-telephone transmitter operated by sound-waves and consisting of a plate sensitive to said sound-waves, electrodes in constant contact with each other and forming part of a circuit which includes a battery or other source of electric energy and adapted to increase and decrease the resistance of the electric circuit by the variation in pressure between them caused by the vibrational movement of said sensitive plate."

These claims must be read in connection with the disclaimer of the patent, which declares that the patentee does not claim to be "the first inventor of the art of transmitting vocal and other sounds telegraphically by causing electrical undulations similar in form to the sound-waves accompanying said sounds," nor to be "the first who caused such electrical undulations by varying the resistance of an electric circuit in which a current was passing."

In view of this disclaimer, the first claim covers only the particular method described for varying the resistance in the circuit to produce electrical undulations similar in form to sound-waves;

and the second claim covers only the instrument or transmitter which embodies this method.

The complainant mainly relies on the first, or method claim. It is contended that the invention covered by this claim was first disclosed by Berliner in his caveat of April 14, 1877. This invention was the method of varying resistance in the circuit by varying the pressure at the point of contact between solid electrodes in constant contact. This way of varying the resistance, it is said, is the same as that disclosed by Professor Hughes a year later, on May 9, 1878, in a paper read before the Royal Society of London. Hughes called his instrument the microphone. The complainant rests its case upon the identity of the Berliner and the Hughes methods of varying the resistance, and upon the priority of invention by Berliner. In the language of complainant's brief, "It cannot be seriously denied, and none of the witnesses deny, that the Hughes article and the caveat describe the same invention." "The complainant stakes its case upon the proposition, firmly established by the testimony, that Emile Berliner was the original and first inventor of the microphone." This position of the complainant is necessary in order to make out infringement. The defendant's transmitters use carbon electrodes; and, unless Berliner first discovered and disclosed the microphonic method of varying resistance, his patent must be limited to the metallic electrodes described in the specification, and the defendants do not infringe. The issue here raised can be more intelligently considered if we briefly review the state of the art at the time Berliner made his invention.

The speech-transmitting telephone presents the problem of the reproduction, by means of an electric current, of a succession of vibrations on the receiving diaphragm which shall exactly correspond to the vibrations of the transmitting diaphragm caused by the air vibrations, or sound-waves, produced by the voice in speaking. The problem was rendered more difficult for the reason that the air vibrations caused by the vocal organs in articulate speech are very complex in form.

On March 7, 1876, a little more than a year before the Berliner caveat appeared, Bell's basic patent was issued, disclosing his art of transmitting speech by creating changes of intensity in a continuous current of electricity exactly corresponding to changes of density in the air caused by the vibrations which accompany vocal sounds. This is known as Bell's undulatory current, which simply means an electric current whose undulations are similar in form to sound waves.

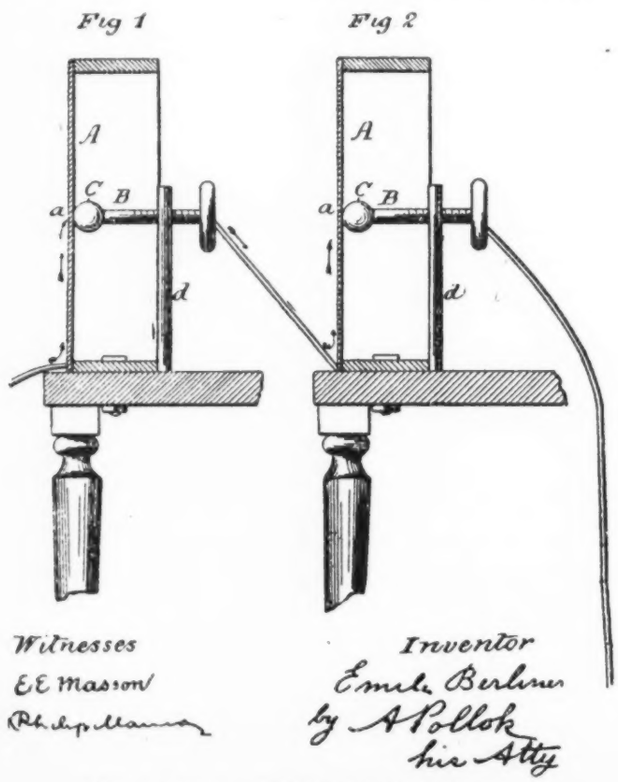
The prior current in the Reis telephone would only reproduce musical tones. It would not reproduce the finer and more complex sonorous vibrations upon which depends the quality of sound which characterizes the human voice. This was because the current was intermittent. Bell discovered that the current must be continuous in order to impress upon it changes which correspond to the form of sound-waves.

The Bell patent also disclosed several ways of utilizing his undulatory current. One way is known as the magneto method, in which the current is induced or generated from the magnetic field surrounding an electro-magnet by the movements of the diaphragm caused by sound-waves. These movements, by altering the condition of the magnetic field, produce a current which corresponds in form to the sound-waves. An undulatory current of this kind, generated by the transmitter itself by means of the slight movements of the diaphragm, is necessarily feeble, and can only transmit speech short distances. Nevertheless, this instrument was the first practical speech transmitter, and the only commercial transmitter in use until it was supplanted by the carbon variable-resistance transmitter. The instrument is illustrated in the accompanying figure (Fig. 3) taken from the Bell patent.

In this drawing a soft-iron armature (c) is caused to vibrate in front of the pole of an electro-magnet (b) by means of a membrane diaphragm (a), moved by the sound-waves, to which diaphragm the armature is attached. This induces or generates an undulatory current in the coil of the electro-magnet, which current passes through another electro-magnet (f) in the same circuit, and causes its armature (h) to perform like-movements to those of the armature of the transmitter, whereupon the diaphragm (l) attached to the second armature, reproduces the same sounds as are uttered into the transmitter. Bell subsequently took out a patent for an improved form of this transmitter, in which the diaphragm itself was of metal, instead of being a membrane with an armature attached to it.

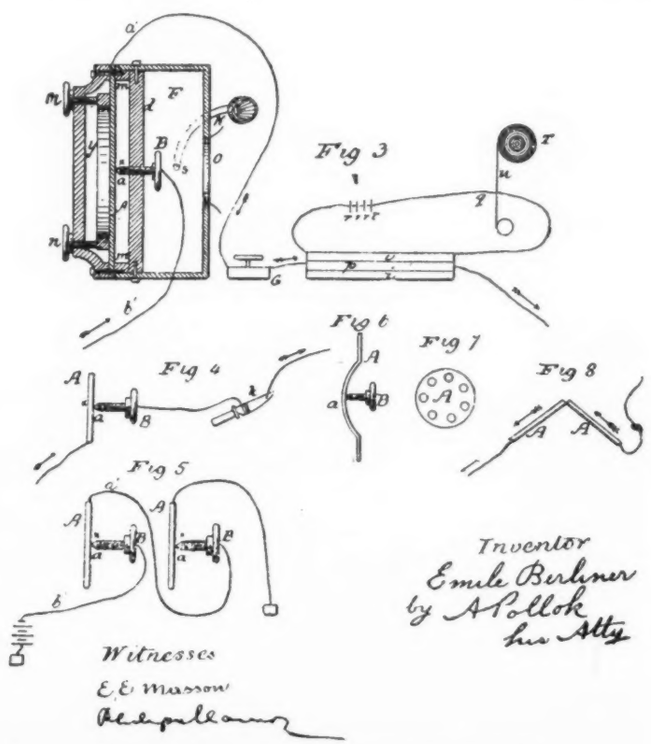
Another way of utilizing Bell's undulatory current, disclosed in his 1876 patent, was by varying the resistance in a battery circuit. This is made the subject of Claim 4, which is for "the method of pro lucing undulations in a continuous voltaic current by gradually

E. BERLINER.
COMBINED TELEGRAPH AND TELEPHONE.
No. 463,569. Patented Nov. 17, 1891.



FIGS. 1 AND 2. BERLINER TELEPHONE.

E BERLINER
COMBINED TELEGRAPH AND TELEPHONE
No. 463,569 Patented Nov. 17, 1891.



DETAIL DRAWING, BERLINER TELEPHONE.

increasing and diminishing the resistance of the circuit." The specification refers to this method and apparatus as follows:

"The external resistance may also be varied. For instance, let mercury or some other liquid form part of a voltaic circuit, then the more deeply the conducting-wire is immersed in the mercury or other liquid, the less resistance does the liquid offer to the passage of the current. Hence, the vibration of the conducting-wire in mercury or other liquid included in the circuit occasions undulations in the current."

The art, as it was left by Bell's primary patent, may be thus summarized: There existed the undulatory current, the only known current which will transmit speech. There existed one form of its application, known as the magneto transmitter or magneto telephone, which went into extensive use for several years, but which would transmit speech only a short distance, owing to the feebleness of the current. There existed also another way of utilizing the undulatory current by varying the resistance in a battery circuit at the contact between electrodes in constant contact, those electrodes being a solid and a liquid. The instrument embodying this method is known as the mercury transmitter.

After these disclosures in the Bell patent, the problem which remained was the invention of a practical transmitter which would utilize the undulatory current by varying the resistance in a battery circuit, and so transmit speech long distances. Bell had supplied the current, and had shown that it could be utilized by varying the resistance in a battery circuit; and what remained was to devise a better way of varying the resistance than was pointed out by Bell. This problem was solved by two discoveries which are now embodied in every commercial transmitter. The first was the discovery of the peculiar properties of carbon in varying electrical resistance, and the second was the discovery of the remarkable effects of sound-waves in varying resistance at a loose contact between solid electrodes. Edison made the first discovery, and the fundamental question for our determination in the case at bar is whether Berliner or Hughes first made the second discovery. The instrument which utilizes both these discoveries is called a microphone transmitter. Every microphone transmitter, as commonly understood in the telephonic art, is an instrument having carbon electrodes in loose or feeble contact. But a transmitter may still be a microphone without having carbon electrodes, provided the

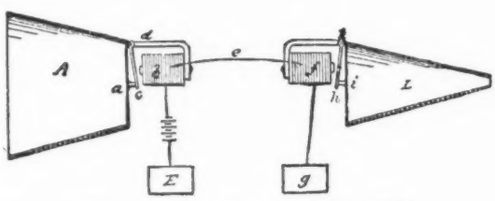


FIG. 3. ORIGINAL BELL INSTRUMENT.

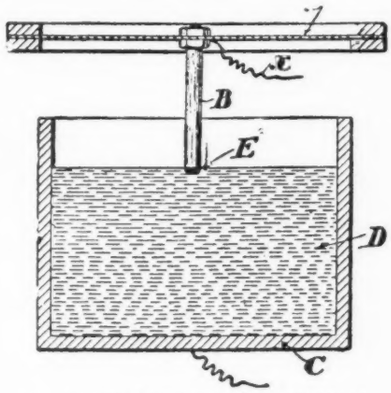


FIG. 4. BELL'S MERCURY TRANSMITTER.

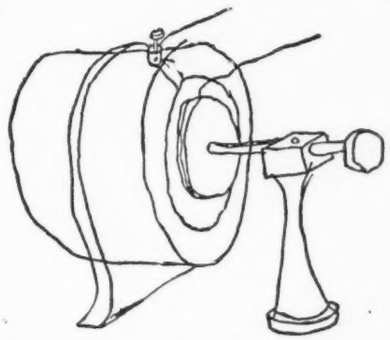


FIG. 5. EDISON PLUMBAGO FILM TRANSMITTER

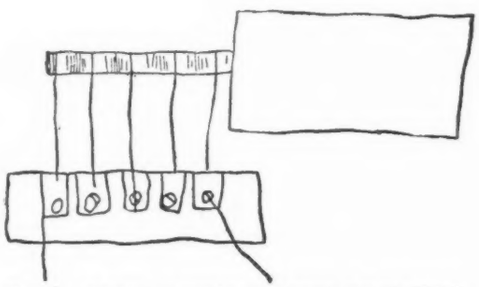


FIG. 6. EDISON PLUMBAGO CYLINDER TRANSMITTER.

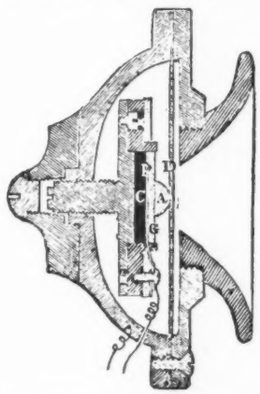


FIG. 7. EDISON CARBON TRANSMITTER.

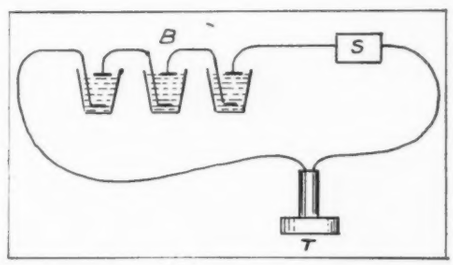


FIG. 8. HUGHES' SOUND DETECTOR.

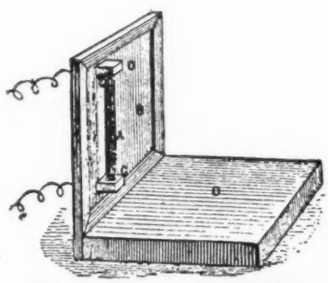


FIG. 9. HUGHES MICROPHONE.

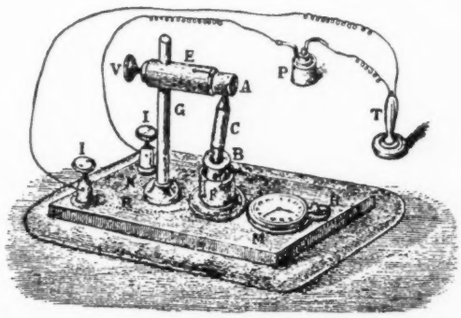


FIG. 10. HUGHES MIGROPHONE (ANOTHER FORM)

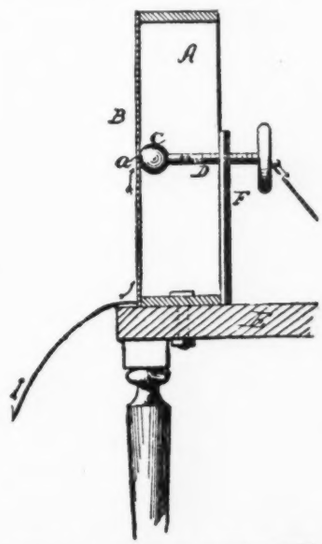


FIG. 11 BERLINER TRANSMITTER.

electrodes are of solid material, and so capable of embodying microphonic action. It is not pretended that Berliner discovered the carbon electrode, but it is maintained that he was the first to discover microphonic action, and to embody that principle in an operative speech-transmitter. If this be true, the complainant may well insist that the claims of the Berliner patent are not limited to metallic electrodes, but cover the microphonic process or art for the reproduction of sound by varying the electrical resistance in a circuit at a loose contact between solid electrodes in constant contact.

Before the consideration of the microphonic method, and Berliner's priority of invention over Hughes, it may help to throw some light on the subject if, at this stage of our inquiry, we briefly trace the development of the variable-resistance transmitter.

After Bell's great contribution to the telephonic art in 1876, the thoughts and efforts of inventors were largely turned in the direction of material and structure, rather than to the discovery of new methods. The only two transmitters then known which used a battery current were the Reis transmitter and the Bell mercury transmitter; and inventors naturally looked for the solution of the variable-resistance transmitter problem along the lines of these instruments. A brief reference to these instruments and those which followed, until we reach the commercial carbon transmitter, will prove instructive.

The Reis transmitter employed a battery current. There was a diaphragm set in motion by sound-waves, and there were two metallic electrodes in loose inconstant contact in the circuit. This instrument would transmit musical sounds, but not articulate speech, because at every full vibration of the diaphragm the electrodes separated, thereby interrupting the current. In structure this instrument is substantially like the Berliner transmitter. Reis failed because he had not discovered that a continuous current, which requires a constant contact between the electrodes, was essential to transmit speech. In spite of this failure, it has been truly said that the telephonic art owes much to Reis.

The next battery instrument was Bell's mercury transmitter, described in his 1876 patent, in connection with his undulatory current. This instrument was operative, but not practical. A sketch, in an exaggerated form, is here given (Fig. 4).

In this drawing (A) is the diaphragm, (B) the wire attached thereto, (D) the mercury or other liquid, and (X) and (Y) the circuit connections. As the diaphragm vibrates, the point (E) moves down and up in the mercury, thereby causing electrical undulations similar in form to sound-waves. Here we have a diaphragm set in motion by sound-waves, and a metallic electrode and a liquid electrode in constant contact. As the vibrations of the diaphragm cause the metal point to be immersed in the liquid, the less resistance there is to the passage of the current. The way or method of varying the resistance in this transmitter is by varying the area of contact between the two electrodes.

In February, 1877, 11 months after Bell's patent disclosed his mercury transmitter, Edison invented what is known as the plumbago-film transmitter. This instrument utilized Bell's undulatory current in a battery circuit by varying the resistance between solid electrodes in constant contact. It was an operative instrument, but not practical. A sketch of the instrument is here reproduced (Fig. 5).

This drawing represents a disk of hard rubber coated with plumbago, which presses against the tinfoil sheet on the diaphragm. One of the line wires is connected to the disk at its upper edge, and the other to the tinfoil sheet on the diaphragm. This sketch was the original from which was made the application for patent No. 474,230. In this instrument we have a diaphragm set in motion by sound-waves, and two solid electrodes in constant contact. The vibrations of the diaphram due to the sound-waves caused it to come into greater or less contact with the disk, and so varied the resistance in the circuit. The thin film of plumbago on the disk being a poorer conductor than the metal diaphragm, the movements of the diaphragm cut in and out the resistance of the circuit. The way or method of varying the resistance in this transmitter would seem to be by varying the extent or area of contact surface between the electrodes caused by the vibrations of the diaphragm, although the patent also speaks of the vibrations as causing an increase and decrease of electric energy according "to the intimacy of contact between the vibrating diaphragm and the surface of the adjacent disk."

We come next to Edison's plumbago cylinder transmitter, which bears the date of April 1, 1877, and which is described in its final form in patent No. 474,231. This instrument also utilized Bell's undulatory current in a battery circuit by varying the resistance between solid electrodes in constant contact. It was an operative speech-transmitter, but not practical. A sketch of this instrument is here given (Fig. 6).

This apparatus comprised a diaphragm in contact with a series of plumbago cylinders mounted on stiff springs which held them in a state of contact. The diaphragm was in constant contact with the plumbago at one end of the series, and by its vibrations varied the resistance in the circuit. In this instrument we have a diaphragm set in motion by sound-waves, and solid electrodes in constant contact. The vibrations of the diaphragm compressed the mass of plumbago, which caused variations of resistance in the circuit. The way or method of varying the resistance in this transmitter is by varying the compression of the mass of plumbago caused by the vibrations of the diaphragm. There would seem to be little doubt that microphonic action would be present in this transmitter, provided the adjustment between the diaphragm and the plumbago cylinders were such as to make a loose initial contact between them.

Next in the order of time is the Berliner transmitter in suit, described in this caveat of April 14, 1877. This instrument, as we have seen, also utilizes Bell's undulatory current in a battery circuit by varying the resistance between solid electrodes in constant contact. It was an operative speech-transmitter. It never went into use, however, as it was not a practical instrument. For the sakes of clearness, the drawing of the transmitter (Fig. 1) is again referred to.

In this instrument we have a diaphragm set in motion by sound-waves, and two metallic electrodes in constant contact. The vibrations of the diaphragm vary the pressure at the point of contact, and thereby vary the resistance in the circuit. The way or method of varying the resistance in this transmitter is by varying the pressure at the point of contact, and so varying the intimacy of contact between the electrodes. When the electrodes in this instrument are so adjusted as to be in loose contact we have present microphonic action, and the instrument becomes a microphonic transmitter. It may here be observed, however, that our inquiry is not whether the Berliner instrument became a microphone when properly adjusted, but whether Berliner first discovered the microphonic way of varying resistance, and made it known to the world in his caveat.

This brings us to Edison's carbon transmitter, which was invented in the fall of 1877, and is found in patent No. 203,016, dated April 30, 1878. The instrument utilizes Bell's undulatory current in a battery circuit by varying the resistance between two solid electrodes, one of which is carbon. The accompanying figure (Fig. 7) shows the commercial instrument.

In this figure (D) is the metal diaphragm resting by means of the small brass tube (A) upon a disk of hard rubber (G), beneath which is a thin plate of platinum foil (P), connected with the battery. Beneath this platinum foil is a button of soft carbon (C), made of highly compressed lampblack, and beneath this is another thin plate of platinum foil, which is connected to the line through the frame of the instrument. The carbon button, with its enclosing plates, was so mounted as to be capable of adjustment by means of a screw. In this instrument we have a diaphragm set in motion by sound-waves, and two solid electrodes in constant contact, one of the electrodes being composed of carbon. "The vibrations of the diaphragm," in the words of the patent, "subject the carbon to different pressures, according to the amplitude of motion resulting from the sound-waves, and this difference of pressure varies the resistance offered by the carbon to the passage of the current, and produces a rise and fall of electric tension." The way or method of varying the resistance in this transmitter is by varying the pressure at the contact and so varying the intimacy of contact between two solid electrodes. In this instrument Edison disclosed to the world his discovery of the special properties of carbon in varying resistance in a telephone transmitter. When the electrodes in this instrument are adjusted in feeble contact it becomes a microphone.

The Edison carbon transmitter was the first practical long-distance speech-transmitter which utilized Bell's undulatory current in a battery circuit by varying the resistance in the circuit. The commercial art passes at once from Bell's magneto transmitter to Edison's carbon transmitter. In December, 1879, there were 34,000 magneto transmitters in use, and 18,000 variable-resistance carbon transmitters. Subsequently, the use of the magneto transmitters declined, and they were supplanted by the carbon transmitter. All variable-resistance transmitters commercially used have carbon electrodes in loose contact. The alleged infringing transmitters in the case at bar are mere improvements in the structure, form or adjustment of the Edison carbon transmitter, invented by him in the fall of 1877.

We now pass to the crucial point upon which the complainant rests its case. The complainant's position on this point may be stated as follows:

Berliner first discovered the microphonic method of varying resistance, and first disclosed this method, and an operative instrument embodying it, in his caveat of April 14, 1877. In other words, Berliner first invented the microphone. Bell's mercury transmitter and Edison's plumbago film and plumbago cylinder transmitters are not anticipations, because they do not operate by the microphonic method. They are not microphones. On the other hand, Edison's carbon transmitter and the two carbon transmitters made or used by the defendants infringe the Berliner patent, because they employ the microphonic method, and are microphones. The microphonic method is not limited to the use of the carbon electrode, but only to the use of solid electrodes, or hard and unyielding electrodes, and therefore the carbon electrode, when there is microphonic action, is within the microphonic method, and infringes the Berliner patent. The microphonic method was disclosed to the scientific world by Professor Hughes in May, 1878,

and was regarded as a wonderful discovery. Hughes called his instrument a microphone, from analogy to the microscope, since he believed it would magnify small sounds. The microphonic method of varying resistance, disclosed by Hughes in 1878, was the same as the microphonic method of varying resistance disclosed by the Berliner caveat in 1877. To be sure, the Hughes instrument, which he was the first to term a microphone, was constructed of carbon electrodes, but this is immaterial, because he states that the best material for the electrodes has not yet been discovered, and because his discovery resides in the method of varying the resistance, and not in the materials composing the electrodes. The disclosure by Berliner of the Hughes method of varying resistance is found by the complainant in the following passages from Berliner's patent, which also appear in substantially like form in his caveat:

"It is a fact that if at a point of contact between two conductors forming part of an electric circuit and carrying an electric current the pressure between both sides of the contact becomes weakened the current passing becomes less intense—as, for instance, if an operator on a Morse instrument does not press down the key with a certain firmness the sounder at the receiving instrument works much weaker than if the full pressure of the hand had been used. Based on this fact I have constructed a simple apparatus for transmitting sound along a line of an electric current in the following manner:

"In Figures 1 and 2 of the drawings (A) is a metal plate well fastened to the wooden box or frame, but able to vibrate if sound is uttered against it or in the neighborhood of said plate. Against the plate and touching it is the metal ball (C), terminating the screw-threaded rod (B), which is supported by the bar or stand (d). The pressure of the ball (C) against the plate (A) can be regulated by turning the rod (B). By making the plate vibrate the pressure at the point of contact (a) becomes weaker or stronger as often as vibrations occur, and the strength of the current is thereby varied accordingly, as already described."

The Berliner invention above described consists in the method of varying the resistance by variation of pressure at the point or points of contact between solid electrodes in constant contact.

To determine whether this invention is the same as the Hughes method of varying resistance, it is necessary to have a clear understanding of the nature of the discovery which he revealed to the world on May 9, 1878.

Such portions of the Hughes article as seem material may be summarized as follows:

The introduction of the telephone led Professor Hughes to investigate the effect of sonorous vibrations upon the electrical behavior of matter. Sir William Thomson and others have shown that resistance to the passage of currents afforded by wires is affected by their being placed under strain, and, inasmuch as the conveyance of sonorous vibrations induced rapid variations in the strain at different points of a wire, Professor Hughes believed that the wire would vary in its resistance when it was used to convey sound. To investigate this he made a rough telephone receiver or "sound detector," which he connected in line with a battery current in a closed circuit. The apparatus or materials experimented upon were used in the same way as the transmitter of the speaking telephone of Bell. The following is a sketch of his apparatus (Fig. 8).

In this drawing (B) is the battery, (S) the source of sound or material examined, and (T) the telephone. He then proceeds:

"I introduced into the circuit at (S) a strained conductor—a stretched wire—listening attentively with the telephone to detect any change that might occur when the wire was spoken to, or set into transverse vibrations by being plucked aside. Gradually, till the wire broke, the strain was varied, but no effect whatever was remarked except at the moment when the wire broke. The effect was but momentary, but invariably, at the moment of breaking, a peculiar 'rush' or sound was heard. I then sought to imitate the condition of the wire at the moment of rupture, by replacing the broken ends, and pressing them together with a constant and varying force by the application of weight. It was found that if the broken ends rested upon one another with a slight pressure, of not more than one ounce to the square inch on the joints, sounds were distinctly reproduced, although the effects were very imperfect."

Professor Hughes had now discovered microphonic action, or the mode of operation of the instrument which he calls the microphone, and all that follows in his paper is only the further development of this principle. He sought to investigate the effect of sonorous vibrations or sound-waves upon the electrical behavior of matter, and he began his investigation with the belief that such vibrations would vary the electrical resistance of wire under strain. He found no marked effect until the moment when the wire broke or parted contact, when he detected a peculiar "rush" or sound. He then imitated the condition of the wire at the moment of rupture by replacing the broken ends in the apparatus, and pressing them together with a constant and varying force by the application of weights. He discovered that, if the broken ends rested together with a slight pressure of not more than one ounce to the square inch on the joints, sounds were distinctly reproduced. Thus Professor Hughes, by a process of deduction and experiment, and advancing step by step, made his great discovery of the effects of sonorous vibrations in varying electrical resistance at a feeble or loose contact between two electrodes. When Professor Hughes placed the two ends of the ruptured wire in contact, he had not discovered microphonic action. When the ends were pressed together with considerable pressure, he had not discovered microphonic action. When the ends were in a very loose contact he had not discovered microphonic action. But when, after repeated experiments with different degrees of pressure, the broken ends rested upon one another with a slight or feeble contact, his hopes were realized. Hughes did not, like Bell, discover a new current, but he did make known the close affinity between sound-waves and an electric current at what electricians were accustomed to term a "bad joint" in an electric circuit. He discovered the sensitiveness, the adaptability of the current at a loose or light contact to vary its resistance in conformity with the vibrations of the air produced by sound-waves. He discovered a new way of varying resistance which has proved of great utility in the telephonic art. Unless anticipated by Berliner, he was the first to disclose this new way, although previously it may have been present in telephone transmitters without the knowledge of the inventors. Professor Hughes' discovery lay to loose initial contact between the electrodes. This is the essence of the microphone. With loose initial contact there is microphonic action; without loose initial contact there is no efficient microphonic action. When the contact between the electrodes is greater or less than a feeble contact, such action is either greatly impaired, or ceases altogether. Microphonic action, or the microphonic method, or the microphonic process or art, discovered by Professor Hughes, is simply the effects of sonorous vibrations in varying resistance at a feeble or loose contact between solid electrodes in constant contact, whereby sound is reproduced at the receiver. Microphonic action is dependent upon three simple conditions, atmospheric vibrations produced by sound-waves, two solid electrodes in feeble contact in a line circuit, and a sound-receiving instrument in the circuit. What produces these effects is unknown. Professor Hughes believed the effects were "due to a difference of pressure at the different points of contact," and that they were "dependent for the perfection of action upon the number of these points of contact." Professor Bell doubted this, and attributed the effects to "a variation in the amount of contact" supplemented by the heat produced at the point of contact. But what causes these effects is immaterial. What we know is that the phenomenon exists, and was disclosed by Professor Hughes in this article.

It may here be observed that the discovery of Professor Hughes relates to the direct effect of the sonorous vibrations upon a loose contact, and that it is not essential to use a diaphragm. The introduction of a diaphragm merely signifies that the sonorous vibrations produce corresponding vibrations in the diaphragm which affect the resistance at the loose contact exactly the same as the direct impact of the sound-waves.

We will now resume the consideration of the article from the point where Professor Hughes discovered microphonic action.

He found it was not necessary to join two wires endwise together to reproduce sound, but that any portion of an electric conductor would do so even when fastened to a board or to a table, and no matter how complicated the structure upon this board, or the materials used as a conductor, "provided one or more portions of the electrical conductor were separated, and only brought into contact by a slight but constant pressure." If the ends of the wire, terminating in two common French nails laid side by side and separated from each other by a slight space, were electrically connected by laying a similar nail between them, sound could be reproduced. "Up to this point," he continues, "the sound or grosser vibrations were alone produced; the finer inflections were missing, or in other words the timbre of the voice was wanting; but in the following experiments the timbre became more and more perfect, until it reached a perfection leaving nothing to be desired. I found that a metallic powder, such as the white powder—a mixture of zinc and tin—sold in commerce as 'white bronze,' and fine metallic filings, introduced at the point of contact, greatly added to the perfection of the result. At this point, articulate speech became clearly and distinctly reproduced, together with its timbre; and I found that all that now remained was to discover the best material and form, to give to this arrangement its maximum effect." The paper then proceeds with a description of his experiments with the best material and form to give the maximum effect. He found carbon an excellent material, but be obtained the best results from mercury in a finely divided state. He refers to the fact that, in his experiments the diaphragms of Reis, Edison and Bell have been "altogether discarded," and that "the variations in the strengths of the currents flowing are produced simply and solely by the direct effect of the sonorous vibrations."

After describing the instrument which he calls a microphone, he says: "The best form and material for this instrument, however, have not yet been fully experimented on. Still, in its present shape, it is capable of detecting very faint sounds made in its presence. If a pin, for instance, be laid upon or taken off a table, a distinct sound is emitted, or if a fly be confined under a table-

glass, we can hear the fly walking, with a peculiar tramp of its own. The beating of a pulse, the tick of a watch, the tramp of a fly, can thus be heard at least a hundred miles distant from the source of sound."

He further says: "It is quite evident that these effects are due to a difference of pressure at the different points of contact, and that they are dependent for the perfection of action upon the number of these points of contact. Moreover, they are not dependent upon any apparent difference in the bodies in contact, but the same body, in a state of minute subdivision, is equally effective."

The instrument he devised is described as follows:

"The microphone, in its present form, consists simply of a lozenge-shaped piece of gas carbon, one inch long, quarter inch wide at its center, and one-eighth of an inch in thickness. The lower pointed end rests as a pivot upon a small block of similar carbon; the upper end, being made round, plays free in a hole in a small carbon block, similar to that at the lower end. The lozenge stands vertically upon its lower support. The whole of the gas carbon is tempered in mercury, in the way previously described, though this is not absolutely necessary. The form of the lozenge-shaped carbon is not of importance, provided the weight of this upright contact piece is only just sufficient to make a feeble contact by its own weight. Carbon is used in preference to any other material, as its surface does not oxidize. A platinum surface in a finely divided state is equal, if not superior, to the mercurized carbon, but more difficult and costly to construct. I have also made very sensitive ones entirely of iron."

A Hughes microphone is shown in the sketch (Fig. 9).

In this figure (B) and (D) are two pieces of wood fastened together, with their planes at right angles to each other. Attached to (B) are two small blocks of carbon (C) (C). Between these a light rod (A) of carbon is supported on small cups in (C) (C). If this microphone is joined in circuit with a telephone and a small battery, the vibrations produced by a fly walking on the base (D) can be distinctly heard in the telephone.

Another sketch of a Hughes microphone is also reproduced (Fig. 10).

In this drawing, the pointed piece of carbon (C) sets loosely in the notches of two pieces of carbon (A) (B). If we place our ear at the telephone (T) we shall hear distinctly not only the ticking of the watch but the friction of the wheels.

Professor Hughes' article was regarded by the scientific world as disclosing a remarkable discovery. The Journal of the Franklin Institute of June 19, 1878, said: "Professor Hughes * * * discovered that when two or more electrical conductors rested lightly upon each other variation in the force of contact, caused by exceedingly feeble, sonorous vibrations, would so vary the electrical resistance as to take up and transmit these vibrations to the distant telephone with great force and distinctness."

The Russian Messenger, in describing Hughes' discovery, said: "It occurred to Hughes to investigate whether the transmission of sound-waves by a wire had any influence on its ability to conduct a galvanic current. If so, then the change of strength of current ought to act on the telephone, and the latter ought to transmit to us the sound. For a long time Hughes' experiments with a tightly drawn wire were without success, but fortunately, because of its great tension, the wire broke. Not wishing to stop his experiment Hughes temporarily tied the ruptured ends, and to his astonishment he noticed that after the rupture of the wire, the telephone began to transmit sounds much better. Minutely investigating this phenomenon he soon convinced himself that the transmission of sounds by telephone is best accomplished when the ends of the wire touch each other lightly, or better still when they are at certain distance from each other, and between them, in light contact with them, there is another body of good electric conductibility, for example, an iron or brass plate, or a piece of carbon. The slightest sound or noise produced near that piece of carbon naturally causes the latter to vibrate. In consequence of these vibrations there is a greater or lesser contact of the conductors of the current, and therefore the latter meets in the circuit a varying resistance, and consequently its strength also varies."

It will be impossible, in our opinion, to find in the Berliner caveat or patent any conception of Hughes' discovery. It would seemingly appear that Berliner had not advanced so far in his conception of microphonic action as Hughes at the moment he heard a "rush" or sound when the ends of the wire parted contact. It will certainly be made plain that Berliner's conception extended no further than the time when Hughes placed the broken ends of the wire in contact, and began his experiments on the effect of sonorous vibrations at different degrees of constant pressure, which finally led to his discovery of microphonic action.

Always keeping in mind that microphonic action involves the conception of sonorous vibrations and loose contact between electrodes, let us turn to Berliner's conception and invention.

Berliner, as appears from his testimony, having already become familiar with Bell's 1876 patent, commenced in January, 1877, "making experiments" in "the speaking telephone." "Some time," he says, "during that month one of the operators in the fire-alarm office in Washington, in showing me about the use of the Morse key, explained the importance of pressing the key down firmly upon its rest or base in order to insure the operation of the sounder promptly. He explained that if the key was not firmly pressed down the sounder might fail to respond promptly, and that was a reason why female operators were often objected to because they did not have sufficient strength to give a good contact between the key and its rest. It immediately occurred to me that if a variation of contact pressure between the circuit-closing key and its rest could produce a variation in the current then a varying pressure between the points of contact could be obtained by the vibration of one or both of them imparted to them by sounds or sound-waves in the air in their neighborhood."

Manifestly, the conception here given is not Hughes' conception, because the essence of microphonic action, which resides in loose contact, is entirely wanting. When the operator told Berliner that the more firmly the fire-alarm key was pressed down the more promptly the sounder operated, he was merely stating a scientific fact, then well known, that the closer the contact ends of a wire in an electric circuit are pressed together, the less the resistance and consequently the greater the strength of the current. Acting upon this information, Berliner says it occurred to him that if a variation of contact pressure between the circuit-closing key and its rest could produce a variation in the current, then a varying pressure between the points of contact could be obtained by the vibration of one or both of these electrodes, imparted by sound-waves in their neighborhood. Berliner's conception of a telephone transmitter was this: Starting with the electrodes in contact, he conceived that a varying pressure between the points of contact, and a consequent varying of the strength of the current, could be obtained by the vibration of one or both of the electrodes caused by sound waves. This conception does not reach to the character of the initial contact, and therefore does not even approach microphonic action.

Suppose Professor Hughes had stopped his experiments when he had placed the ends of the severed wire in contact, he would not have discovered microphonic action. Or suppose, after the wire broke, he had said: "I then placed the two ends of the wire in contact, and found that the sonorous vibrations would vary the pressure at the points of contact, and so vary the strength of the current, whereby sound was reproduced," he would have made no discovery of microphonic action. If, however, Hughes had embodied this conception in a telephone transmitter, he would have made an invention, in that he had discovered that the minute atmospheric vibrations due to sound-waves would sometimes so vary the pressure between the points of contact of metallic electrodes as to strengthen and weaken the current, and so reproduce sound. And this is exactly the scope of the Berliner conception, and of his invention. His conception, by reason of the absence of any comprehension of microphonic action, when embodied in a transmitter, produces an instrument which is sometimes operative and sometimes not. If, by accident, the electrodes are adjusted in loose initial contact, or microphonic contact, the instrument may be operative, while, if not so adjusted, it is inoperative.

But while Professor Hughes, under such circumstances, would have made an invention, he could not have seriously asserted that he had discovered microphonic action, because we know that when he placed the ends of the wire in contact, he had not made his discovery, and that it was only after repeated experiments with all degrees of contact pressure he found the ends must be placed in loose contact to insure the reproduction of sound.

Contact, or points of contact, are meaningless as a conception of microphonic action. So, likewise, is the conception of varying pressure at the contact or points of contact. A contact, or points of contact, affected by varying pressure, may be a firm contact, in which case there is no microphonic action, or a very loose contact, in which case there is no microphonic action, or any other degree of contact where microphonic action is not present. Microphonic action resides in the conception of a loose initial contact between the electrodes, and it is immaterial to this conception how the sound-waves affect such a contact, whether by varying pressure or not. This shows that it is only the clear comprehension of loose contact which can be held to be a conception of microphonic action. A conception of microphonic action which omits loose contact leaves out the very essence of the thing to be conceived.

Berliner testified to this conception of this invention on April 12, 1879, in some interference proceedings. This was two years after the filing of his caveat, and one year after the publication of the Hughes article. So far as this description of his invention may differ from that found in his caveat, we must, of course, be guided by the latter. It is the invention disclosed in the caveat upon which the complainant must, and does in fact, rely.

Berliner begins his caveat by the statement of the fact which the operator had previously told him, though he now speaks of the pressure at "a point of contact," instead of the pressure between "the points of contact."

"It is also a fact that if at a point of contact between two ends of a galvanic current the pressure between both sides of the contact becomes weakened, the current passing becomes less intense, as, for instance, if an operator on a Morse instrument does not

press down the key with a certain firmness, the sounder at the receiving instrument does work much weaker than if the full pressure of the hand would have been used. Based on these two facts I have constructed a simple apparatus for transmitting sound along a line of a galvanic current in the following manner."

The drawing of the transmitter is here reproduced (Fig. 11).

"In the drawing accompanying this caveat (B) is a metal plate well fastened to the wooden box or frame (A), but able to vibrate if sound is uttered against it or in the neighborhood of said plate. Against the plate and touching it is the metal ball (C), which rests on the bar or stand (F) and presses against the plate which pressure, however, can be regulated by the thumb-screw (D) attached to the ball. By making the plate vibrate the pressure at the point of contact (a) becomes weaker or stronger as often as vibrations occur and according to it from which side of the plate the sound comes."

It is impossible to find in this language any description of microphonic action.

Referring to the figure, Berliner says:

"Against the plate and touching it, is the metal ball (C), which presses against the plate, which pressure, however, can be regulated by the thumb-screw (D) attached to the ball."

This is simply saying that the electrodes are in constant action, and that the degree of contact may be regulated by the thumb-screw. But in what matter it is to be regulated, or what is to be the degree of pressure caused by such regulation, the caveat is silent. Presumably, by experiment with different degrees of adjustment, the pressure between the electrodes is to be so regulated that the instrument will operate to transmit speech. But how can this be said to be a disclosure of microphonic action? The operator gets no knowledge from this description of the degree of initial contact pressure which is necessary. If he presses the ball and plate too closely together the instrument becomes inoperative. If the contact is too loose, a like result follows. But if, after frequent attempts, he happens to make such an adjustment as gives a feeble contact between the ball and the plate, the instrument may become operative. Can it for a moment be maintained that this is the discovery revealed by Professor Hughes?

The caveat continues:

"By making the plate vibrate [by sound-waves] the pressure at the point of contact (a) becomes weaker or stronger as often as vibrations occur."

This may all be true, and this feature may have involved invention, but it has no bearing on the disclosure of microphonic action. These words are merely descriptive of what takes place after some kind of an adjustment between the ball and plate has been made. The discovery of microphonic action resides in the particular kind of adjustment and not in the fact that after such an adjustment the vibrations of the diaphragm caused by sound-waves vary the pressure at the point of contact.

To make still more clear the distance which separated Berliner from any conception of microphonic action, we may turn to another passage from his caveat, which says:

"Some instrument to be used as a transmitter of sound-waves, by uttering sound against or in the neighborhood of the said plate or its mechanical equivalent, thus vibrating the plate and diminishing the amount of electricity passing as many times and as much as the vibrations will loosen the pressure of contact, as described."

Berliner's mind was still full of what the operator had told him about the fire alarm. He believed, as this passage shows, that the electrodes must be first firmly pressed together, in which case the current would flow freely, and that the vibrations of the plate due to sound-waves would lessen the pressure of contact and so diminish the amount of current flowing as often as the vibrations occur. He consequently started with a firm initial contact between the electrodes, and his theory was that the vibrations of the diaphragm would lessen the contact. This is the reverse of microphonic action, which starts with a loose initial contact, and, consequently, a greatly diminished flow of current.

On April 30, 1877, 16 days after the filing of the caveat in suit, Berliner filed another caveat, which describes an ingenious arrangement for "producing sound by the noise of sparks." On May 9, 1877, nine days afterwards, Berliner filed a third caveat for what is known as his double-pin instrument. This was for an improvement on the ordinary make-and-break transmitter, by the use of a double contact. Then follows, on June 4, 1877, the application for the patent in suit, covering, with the receiver, single-pin transmitters and double-pin transmitters, continuous currents and intermittent currents, in such a confused way that an intelligent and satisfactory interpretation of this document bids defiance to the human understanding. The obscurity of the paper may be in part accounted for by the blunders of the solicitor's clerk, but not wholly; for it is quite manifest that Berliner's ideas at this time as to the best form of transmitter, and the principle of its operation, were unsettled and needed clarification. This course of action on the part of Berliner may not be conclusive of anything. It is sometimes unsafe to infer too much from a subsequent line of conduct. In this particular case, however, we think this much may be said with truth:

Assuming that Berliner, on April 14, 1877, had already made Hughes' discovery of microphonic action, his caveat of May 9th and his application of June 4th become incomprehensible.

In this connection it may be noticed that, in his two patents for microphones, No. 222,652 and No. 224,573, applied for more than two years after his caveat, and more than a year after the publication of the Hughes article, Berliner describes the necessity of loose initial contact between the electrodes. In the first instance, one of the electrodes, which is preferably of carbon, is described as "just in contact by its own weight with said plate," and in the claim as "the said non-elastic pin resting solely by its own weight upon the diaphragm." The second patent is for maintaining the carbon pin constantly in light contact with the diaphragm "by the action of gravity," or, in the words of Claim 1, "an opposite electrode maintained in contact with the vibrating surface by the action of gravity." Here is the loose initial contact of Hughes, and the maintenance of such a contact during the operation of the instrument.

Berliner's attempts to make his transmitter reproduce speech were hardly satisfactory; but, as the evidence stands, he succeeded in reproducing some words, and indistinct sentences, so that it may be said there was the transmission of the quality of sound which characterizes the human voice in speaking. In his experiments with the instrument he says nothing about loose contact between the electrodes, or the necessity of such contact. That his efforts were not more successful he believes was owing to the crudeness of the apparatus and the difficulty of adjusting it. His apparatus, however, was not more crude than the apparatus which Hughes used in his experiments. The unsatisfactory character of Berliner's efforts cannot be wholly ascribed to this cause, nor to the fact that he used metallic electrodes, which, for several reasons, are difficult properly to adjust, nor to both of these causes combined, but must have been due, at least to some extent, to his ignorance of microphonic action. Had he known of Hughes' discovery, the results, in all probability, would have been much more satisfactory. Subsequent experiments, however, have shown that the Berliner instrument can be so adjusted as to become an operative speech transmitter. But the experts who made these experiments years afterwards had been long familiar with Hughes' disclosure of microphonic action, and they knew the absolute necessity of loose initial contact between the electrodes in order to make the instrument an operative speech transmitter. They certainly possessed this advantage over Berliner, and the success of their efforts may be attributed in part to this cause.

The complainaint's contention that Hughes' discovery of microphonic action is disclosed in the Berliner caveat rests upon general definitions of the microphone and of Berliner's invention rather than upon a critical analysis of the actual discovery revealed by Hughes in his article, or a critical examination of the Berliner caveat.

The definition of the Berliner invention is founded on what the complainant conceives to be the "true definition of a microphone," which is as follows:

"The essence of the microphone consists therefore in varying the resistance at the 'joint' or point of contact between two electrodes by varying the pressure between them."

But this is not descriptive of the microphone, or of microphonic action, as disclosed by Hughes. "A joint" may be either tight or loose, and a "point" of contact" may be either firm or feeble, and the difference between a joint and a loose joint, and a point of contact and a feeble point of contact, is the difference between what is a microphone and what is not a microphone. This is confirmed by the testimony of complainant's experts.

Professor Cross says, defining microphonic action:

"It is a fact that when a current passes from one electrode to another kept loosely in contact with it, there is a certain resistance of passage or 'transition resistance,' as it may be called, at the surface of contact between the two electrodes."

And Professor Wright says:

"When transmitting speech, the electrodes of a microphonic transmitter are brought together with a pressure which is very light, and which has been determined by experiments to vary within a comparatively narrow range."

This error is present in every definition of the microphone and of the Berliner invention in complainant's brief, and it permeates and undermines the fundamental position on which it rests the case.

Again, the Berliner invention is defined as "varying the pressure at a point of contact between electrodes," or "varying the pressure between two electrodes in contact and thereby varying the resistance in the circuit so as to produce undulatory sound-waves." More fully stated, the definition may be expressed as follows: The method of varying resistance by variation of pressure at the point of contact between solid electrodes in constant contact. These definitions are not descriptive of the microphone or of microphonic action, because they omit any reference to loose contact between the electrodes.

The complianant then proceeds to define what it calls Professor Hughes' "brilliant and radically novel discovery" in substantially the same terms, as follows:

"It was recognized that the essence of this discovery lay in the

variation of pressure at a point of contact between two electrodes in a galvanic circuit, thereby varying the resistance which such 'joint' offers to the passage of the current."

Again:

"The method of varying resistance by varying the pressure at a point of contact between electrodes, which was set forth in Berliner's caveat and subsequently in Professor Hughes' article, was instantly recognized as solving the problem of the 'battery-speaking telephone.'"

Again:

"Hughes says that he may use one contact (like two ends of wire) or a larger number of points of contact, and that he may use either metal or carbon contacts, the one essential thing being the 'difference of pressure at the different points of contact.' Berliner's caveat describes the invention as resting on variation of pressure at a point of contact between the electrodes, and says that the plate which forms one of the electrodes may be of any material, and that there may be more than one point of contact."

From these comparisons follows this conclusion:

"It cannot be seriously denied, and none of the witnesses deny, that the Hughes article and the caveat describe the same invention."

In this comparison of the Berliner and Hughes inventions, it will also be observed that no mention is made of loose contact, or feeble contact, or light contact, and that, consequently, all of these descriptions are wanting in any reference to the essence of microphonic action. What Hughes disclosed to the world, as we have seen, was not varying the pressure at the point of contact; nor did the essential thing which he discovered lie in the difference of pressure at different points of contact. His discovery resided in loose contact, or rather in the remarkable effects of sonorous vibrations in varying resistance at a loose contact. He also made loose contact between the electrodes the indispensable feature of his microphone. In describing that instrument in his article, he says: "The form of the lozenge-shaped carbon is not of importance, provided the weight of this upright contact piece is only just sufficient to make a feeble contact by its own weight." He believed that these effects were due to pressure at the points of contact. This, however, was simply his theory of what took place, his theory of microphonic action. Except in alluding to this theory near the close, the word "pressure," throughout the article, has reference to initial contact pressure. "Variation of pressure at a point of contact" may be descriptive of Berliner's invention, but, to say the least, it is a mistaken and misleading description of microphonic action and of Professor Hughes' discovery.

Again, the first and most important claim of the Berliner patent fails to define the microphonic method of Hughes. The claim is for "the method of producing in a circuit electrical undulations, similar in form to sound-waves, by causing the sound-waves to vary the pressure between electrodes in constant contact so as to strengthen and weaken the contact and thereby increase and diminish the resistance of the circuit." It will be observed that the claim is silent as to the character of the initial contact between the electrodes. The claim must be read as if written April 14, 1877, a year before the Hughes discovery. With such knowledge of the telephonic art as existed at that time, no one would have known from this description of the Berliner method that the electrodes must be adjusted in a loose initial contact. In omitting any reference to loose contact, the claim fails to disclose the essence of the Hughes microphonic method.

The complainant has rested its case on the prior discovery by Berliner of microphonic action as disclosed by Professor Hughes in his article of May 9, 1878. We are of the opinion that Berliner had no conception of this discovery, that he does not disclose such discovery in his caveat or patent, and that, if his transmitter operated as a microphone, it did so without any knowledge on his part of the microphonic principle. The world was left in the same ignorance of microphonic action after the appearance of his caveat as before. If Professor Hughes had had lying on his table a Berliner transmitter and the Berliner caveat, they would have revealed nothing to him, nor have been of any assistance in the experiments which resulted in his discovery of the remarkable effects of sound-waves in varying electrical resistance of a loose or feeble contact. If he had taken the diaphragm and metal ball of the Berliner instrument in place of the ends of his wire, he must have gone on experimenting with the effect of sonorous vibrations at different degrees of initial pressure between the plate and ball, until he had discovered that only with a slight pressure, or feeble contact, is there microphonic action. Professor Hughes' discovery cannot be read into the Berliner caveat or the claims of the Berliner patent.

In connection with the invention set forth in the Berliner caveat, the complainant's experts dwell on "transition resistance," and the fact that such resistance varies enormously with pressure. "Transition resistance" is only another name for loose-contact resistance, or microphonic resistance, and it was Hughes, not Berliner, who discovered transition resistance in the telephonic art, and the effects of sound-waves in varying such resistance.

It was in its rebuttal testimony that the complainant fully brought out its contention that Berliner was the prior inventor of the microphone. In the opening testimony the complainant seemed to rely more upon the variable-pressure theory of the Berliner invention. Professor Cross, adopting Professor Barker's language in the government case, defines the invention of the Berliner patent as "a transmitter whose operation was based upon the variation of electrical resistance by variation of contact pressure." Again Professor Cross says:

"It is what is known as a variable-pressure contact transmitter. It operates, not as did the magneto transmitter to generate the undulatory current produced by the small amount of energy which the voice can communicate to the transmitter, but simply to impress upon the electrical current furnished from another source—practically a battery—variations in strength which correspond to the motions impressed by the voice upon the transmitter. The current from the battery, in flowing through the two electrodes (as they are called) of the transmitter, when these are set into vibration by the voice, is molded by their variations of pressure into a shape similar to that of the air-vibrations of the air-particles themselves; that it is molded into Mr. Bell's undulatory current."

"Pressure" and "variation of pressure" in the telephonic art usually refer to the effects of the movements of the diaphragm caused by sound-waves at the contact between the electrodes. In every variable-resistance transmitter the sound-waves vibrate the diaphragm, and the movements of the diaphragm cause variations of pressure at the surface contact between the electrodes, which vary the resistance and thereby reproduce speech.

"Variable pressure," however, in connection with the Berliner invention, is used by the complainant in a special sense. It signifies variations of pressure which vary the intimacy of contact between solid electrodes, and so vary the resistance, as distinguished from variations of pressure which vary the area of contact between a solid electrode and a liquid electrode, or the area of contact between two solid electrodes, or vary the compression of the mass between solid electrodes.

These distinctions may be further illustrated: If we cut the wire in an electric circuit, and place the severed ends in contact, it will be found that, by varying the pressure at the contact the resistance will be varied, and consequently the strength of the current. This was a well-known fact in electrical science long before 1876. Here the variation of pressure may be said to vary the resistance by varying the intimacy of contact at the surface ends of the wire, although it is manifest that the varying pressure must also cause, in some slight degree, a varying area of contact. If, instead of two ends of a wire, we have one end of a wire and a liquid in constant contact, it is apparent that by pressing the wire down more or less, or by varying the pressure on the wire, the resistance will be varied, and consequently the strength of the current. Here variation of pressure may be said to vary the resistance by varying the area of contact, although the intimacy of contact also will be varied in some degree. Again, if in place of the two ends of a wire, or the ends of a wire and a liquid, we have the end of a wire and some compressible solid material, like plumbago, in constant contact, it is equally clear that by varying the pressure on the wire the resistance will be varied, and consequently the strength of the current. Here variation of pressure may be said to vary the resistance by varying the compression of the mass of material rather than by varying the intimacy of contact, or area of contact.

Turning now to the telephone-transmitter art, we find that none of these ways of varying resistance by varying pressure has advanced the art, or made any impression upon it. These ways of varying resistance, and the difference between them, have been brought out and emphasized by the learned and skilled experts in the case at bar. These ways are simply the different modes of operation of the materials which compose the electrodes. They certainly cannot form the basis for any method-patent covering all materials whose mode of operation is the same, because there is nothing in the so-called area-varying method, or density-varying method, or intimacy-of-contact-varying method, considered by themselves and apart from the discovery of microphonic action, or the special properties of some material like carbon, which has ever contributed anything to the progress of the telephonic art.

The terms "pressure" and "variation of pressure," considered by themselves, are mere abstractions, and cannot involve invention. There may be instances, however, where an invention may be said to reside in the discovery of "pressure," or "variation of pressure," and their utilization in the telephonic art. For instance, Edison may have discovered that carbon or plumbago varied its resistance greatly under pressure; and, if this discovery were embodied in a telephonic transmitter, the invention might be said to reside in his discovery of "pressure," or "variation of pressure," in a particular material. Again, some one might have discovered that the resistance varies enormously with pressure at a loose contact between electrodes; and, if this discovery were embodied in a telephone transmitter, the invention might be said to reside in the discovery of pressure, or variation of pressure at a loose contact. It cannot be said, however, that Berliner made any discovery of pressure or variation of pressure, which has proved of any utility in the art. His discovery, as we have seen, of the variation of pressure at a point of contact between metallic electrodes in a telephone transmitter possessed little utility and was practically worthless. It may have been an invention, in that he discovered that the minute vibrations of the diaphragm due to sound-waves, by varying

the pressure at the contact between metallic electrodes, as distinguished from other kinds of electrodes, vary the resistance and reproduce sound; but this is the limit of his invention, in the absence of any discovery of microphonic action springing from loose contact between the electrodes.

To summarize our conclusions respecting the variable-resistance transmitter:

We find that Bell, in March, 1876, discovered that the minute atmospheric vibrations due to sound-waves would cause the diaphragm to vibrate, which vibrations, by varying the pressure between a solid electrode and a liquid electrode in constant contact, produced variations of electrical resistance, whereby speech may be transmitted.

We find that Edison, in February, 1877, discovered that the minute atmospheric vibrations due to sound-waves would cause the diaphragm to vibrate, which vibrations, by varying the pressure between two solid electrodes of different conductivity in constant contact, one metallic and the other hard rubber covered with a plumbago film, produced variations of electrical resistance, whereby speech may be transmitted.

We find that Edison, on April 1, 1877, discovered that the minute atmospheric vibrations due to sound-waves would cause the diaphragm to vibrate, which vibrations, by varying the pressure between two solid electrodes in constant contact, one metallic and the other compressible plumbago, produced variations of electrical resistance, whereby speech may be transmitted.

We find that Berliner, on April 14, 1877, discovered that the minute atmospheric vibrations due to sound-waves would cause the diaphragm to vibrate, which vibrations, by varying the pressure at the point of contact between metallic electrodes in constant contact, produced variations of electrical resistance, whereby speech may be transmitted.

All of these discoveries, when embodied in transmitters, were inventions, but none of them was a commercial instrument, or solved the problem of a practical long-distance speech transmitter.

We find that, in the fall of 1877, Edison discovered the carbon electrode; that this discovery represents the first marked advance in the transmitter art since the 1876 Bell patent; and that the carbon electrode is found in every commercial battery transmitter.

We find that in May, 1878, Professor Hughes discovered microphonic action, or the fact that sound-waves produce remarkable variations of resistance at a loose or feeble contact between solid electrodes in constant contact, whereby speech may be transmitted; that the principle he then made known is utilized in every practical battery transmitter; and that he embodied his discovery in an instrument, which he was the first to term a microphone.

We also find that Edison's discovery of the carbon electrode and Hughes' discovery of microphonic action solved the problem of a variable-resistance transmitter, whereby speech may be transmitted long distances; and that both these discoveries are embodied in the defendants' transmitters.

We also find that the two claims of the Berliner patent in suit, although upon their face open to the objection of excessive breadth, may be sustained when read in connection with the specification, provided they are limited to metallic electrodes, and that, when so limited, the defendants' transmitters do not infringe.

Our conclusion is that the decree of the Circuit Court must be affirmed on the ground of non-infringement.

The decree of the Circuit Court is affirmed, with costs for the appellees.

COPY OF BERLINER PATENT APPLICATION.

In order to enable the readers of TELEPHONY to closely follow the preceding decision, we append a full copy of the Berliner specifications, the illustration to which appears on page 86.

To all whom it may concern:

Be it known that I, Emile Berliner, of Washington, in the District of Columbia, have invented a new and useful improvement in combined telegraph and telephone of which the following is a specification:

My invention consists in a new and useful improvement in transmitters for electrically transmitting sound of any kind, of which the following is a specification:

It is a fact that if at a point of contact between two conductors forming part of an electric circuit and carrying an eletric current the pressure between both sides of the contact becomes weakened, the current passing becomes less intense—as, for instance, if an operator on a Morse instrument does not press down the key with a certain firmness the sounder at the receiving instrument works much weaker than if the full pressure of the hand had been used. Based on this fact I have constructed a simple apparatus for transmitting sound along a line of an electric current in the following manner:

In Figures 1 and 2 of the drawings, A is a metal plate well fastened to the wooden box or frame, but able to vibrate if sound is uttered against it or in the neighborhood of said plate. Against the plate and touching it is the metal ball C, terminating the screw-threaded rod B, which is supported by the bar or stand *d*. The pressure of the ball C against the plate A can be regulated by turning the rod B. The said ball and plate are included in circuit with an electric battery, so that they form electrodes, the current passing from one of them to the other. By making the plate vibrate the pressure at the point of contact *a* becomes weaker or stronger as often as vibrations occur, and the strength of the current is thereby varied accordingly, as already described. By placing now, as is shown in the drawings, one such instrument in the station Fig. 1, and another instrument capable of acting as a telephonic receiver in the station Fig. 2, both situated on the same electric current in which a current is passing (as shown by the wire connections following the arrows), sound uttered against the plate of the instrument Fig. 1 will be reproduced by the plate of the instrument Fig. 2, for as the vibrations of the transmitter Fig. 1 caused by the sound will alternately weaken and strengthen the current as many times as vibrations occur, the diaphragm of the receiver will be caused by these electrical variations to vibrate at the same rate and measure. The latter vibrations being communicated to the surrounding air, the same kind of sound as uttered against the transmitter Fig. 1 will be reproduced at the receiver Fig. 2, or in as many other receiving instruments as are situated within the same electric current.

It is not essential that the plate should be of metal. It can be of any material able to vibrate if only at the point of contact suitable arrangement is made so that the current passes through that point. The plate may be of any shape or size, or other suitable vibratory media may be used—a wire, for example. Any other metallic point, surface, wire, etc., may be substituted for the ball. There may be more than one point of contact to be affected by the same vibrations. Both of the electrodes may vibrate, although it is preferable that only one should. If the uttered sound is so strong that its vibrations will cause a breaking of the current at the point of contact in the transmitter, then the result at the receiving instrument will be a tone much louder, but not as distinct in regard to articulation.

I have also embodied my invention in and used it in connection with some other forms of apparatus.

In the drawings Fig. 4 represents a detached view of the vibratory diaphragm, showing its relative situation to the poles f the galvanic current. Fig. 3 represents a view of a complete apparatus; Fig. 5, a view of the diaphragms arranged to receive and transmit the sound waves; and Figs. 6, 7 and 8 modifications of the vibratory diaphragm.

In the drawings the letter A represents a diaphragm or plate of thin metal, of limited conductive capacity, such as iron, steel, German silver, platinum, secured in the frame *m m* in the box F in any convenient manner.

The letter *y* represents a ring resting against one side of said diaphragm and capable of being made to bear upon the same with more or less force by means of set screws *n*, in order that the tension of the diaphragm may be regulated.

The letter B represents a screw or pin of metal, pointed at one end and mounted in a cross-piece *d* in such position that the point will be in contact with the diaphragm A. The diaphragm A is connected with one pole of a battery by means of a wire *a'*, and the pin or screw B with the other pole by means of a wire *b'*.

The box F of Fig. 3 is provided with a tube K, to which the ear of the operator may be applied, in order to hear the sounds produced by the vibratory diaphragm when the instrument is employed as a receiver, and a tube O, through which he can speak when employing the instrument as a transmitter, so that the operator is not in need of moving the instrument or moving his head while carrying on a conversation.

Instead of employing a single vibratory plate, as shown in Figs. 1, 2, 3, 4 and 5, in each instrument, two such plates may be employed, as illustrated in Fig. 8, said diaphragms being connected to the respective poles and in contact with each other at their edges, as shown in Fig. 8.

The diaphragm of my improved receiver or the diaphragm of any magneto-receiver (such as those described by Alexander Graham Bell in his patent No. 174,465 of March 7, 1876, and in his patent No. 186,787 of January 30, 1877) will receive a particularly strong shock at the setting in and sudden cessation of the current when a ticking sound will be heard from the plate; but a weakening of the current alone can also be observed most distinctly and accurately by making, for example, a connection within the same circuit by a wire and the blade of a knife *k*, Fig. 4. When scraping the wire end over the blade of the knife, this scraping is distinctly audible on the plate. Here the current is never entirely interrupted, yet the minute elevations and cavities on the blade, caused by the structure of the steel, and which again cause minute alterations in the intensity of the current, are sufficient to shake or vibrate the plate with varying intensity, thus rendering again the same peculiar scraping noise. If, now, the plate of one instrument, as in Figs. 1 or 5, is vibrated by sound waves (which happens whenever any kind of sound is uttered or is produced by musical instruments in its neighborhood) every wave or vibration that strikes the plate produces between the two sides of the contact a variation of pressure, which causes a variation of resistance at that point, and therefore a variation in the strength of the passing current, and if the sound is sufficiently strong it will break the circuit at said point of

contact, the variations in the current thus produced causing similar vibrations in the plate of the receiving instrument. The essential part of the apparatus is the point of contact, which must offer a resistance to the current.

It is not necessary in the transmitting apparatus that the plate should be of conducting material, for any substance capable of vibration will answer, if only at the point of contact provision is made for the current to pass. It is sometimes convenient to use a vibrating plate in the form of a reflector, as shown in Fig. 6, for concentrating the sound, or the diaphragm may be provided with a number of apertures to disperse the sound, as shown in Fig. 7. These apertures prove advantageous with strong sounds, particularly the hissing sounds, as while the sound waves are rushing toward the diaphragm, those touching the plate are repelled and partially destroy the following waves, just as the sea waves when forced against a cliff will be thrown back, destroying those directly behind. The holes permit most of the waves to pass to the other side of the plate, making the vibration of the plate more perfect and even.

I will here describe a recording apparatus which, however, I do not claim.

In Fig. 3 G is a galvanometer, which is located in circuit with the contact pieces or electrodes A B, and which serves as a convenient means for ascertaining the adjustment of the contact pieces of the transmitter, so that a current shall pass. *i p i* is a Ruhmkorff coil or induction apparatus. When a current passes through the primary coil *p* and suddenly is broken, a spark will rush over between the ends of the secondary coil *i i* at *q*. This spark is accompanied by a peculiar sound due to the electric discharge, and if we bring between the ends of the secondary the connecting points *r r r r* a spark will occur between each of them, provided they are near enough to each other, and the peculiar sound will be heard between each of them. I now arrange a strip of chemically prepared paper or other substance *n* to be drawn by clockwork T between the ends of this secondary wire at *q*. Said strip can be prepared in such a way that each spark will produce a mark upon it. If, therefore, the plate A vibrates by sound, each vibration causing a break of contact will produce a spark at *q*, and the strip being drawn through, a succession of marks will be produced upon the strip according to the number of vibrations caused by the sound; but at the same time the sound which was uttered at the plate A will be heard from the sparks rushing over the points *r r r r* and *q*, because every spark produces one wave in the atmosphere in which it occurs, and a certain number of waves will therefore produce certain tones. Therefore, the same sound which is uttered against the plate A will be heard from the sparks. The scraping of the wire end on the knife blade *k*, as in Fig. 4, in the primary current, will also be heard between the wire ends of the secondary current at *r r r r* and *q*. This permits a number of designs for a receiving apparatus within the secondary current. For instance, initials, ornaments, etc., consisting of a number of metal pins, can be constructed in such a way that whenever a tone is produced against the plate A a spark will rush over said metal pins, and at the same time their sound is produced will render the design visible in illuminated characters.

By making the person of the operator a part of the secondary circuit and discharging the sparks in the body in the neighborhood of the ear, the sound will be more particularly apparent.

It will be observed that in Figs. 1 and 2 one of the electrodes presents a convex curvilinear surface like a rounded knob. This possesses some advantages, among which are ease of construction and durability, because it does not wear away the opposing electrode as much as a sharp one would, and when the contact with the vibrating body is made of such form the freedom of the vibration is less interfered with.

I do not claim that I am the first inventor of the art of transmitting vocal and other sounds telegraphically by causing electrical undulations similar in form to the sound waves accompanying said sounds. Neither do I claim that I am the first who caused such electrical undulations by varying the resistance of an electric circuit in which a current was passing.

I do not herein claim the novel form of vibratory plate receiver which I have described, because that is a subject of claim in another application.

I claim—

1. The method of producing in a circuit electrical undulations similar in form to sound waves, by causing the sound waves to vary the pressure between the electrodes in constant contact so as to strengthen and weaken the contact and thereby increase and diminish the resistance of the circuit, substantially as described.

2. An electric speaking telephone transmitter operated by sound waves, and consisting of a plate sensitive to said sound waves, electrodes in constant contact with each other and forming a part of a circuit which includes a battery or other source of electric energy, and adapted to increase and decrease the resistance of the electric circuit by the variation in pressure between them caused by the vibrational movment of said sensitive plate.

3. The combination, with the diaphragm and vibratory electrode, of a rigidly held opposing electrode in constant contact with the vibratory electrode, substantially as described.

4. In a telephonic transmitter, a vibrational plate made concave for condensing the sound, substantially as set forth.

5. In a telephonic transmitter, a vibrational plate provided with one or more apertures, as and for the purposes set forth.

6. A speaking telephone transmitter comprising a diaphragm or disc sensitive to sound waves, combined with a rigidly held but adjustable electrode in contact with the same, whereby the electric current is transformed into a series of undulations corresponding with the vibrations of said diaphragm.

In testimony that I claim the foregoing I have hereunto set my hand in the presence of the subscribing witnesses.

EMILE BERLINER.

QUESTIONS AND ANSWERS

Conducted by J. C. KELSEY, Professor of Telephony, Pardue University.

We have a grounded circuit, with twenty bridging telephones. I tried running a loop off of the main wire to a telephone, and to the telephone I made a metallic circuit. It would ring all right, but no one on either side of the new telephone could ring through, but could talk all right. Is there any way that a person could fix it, so it would work without changing the rest of the telephones to metallic?—W. R.

In Fig. 7, consider a line of the above characteristics,

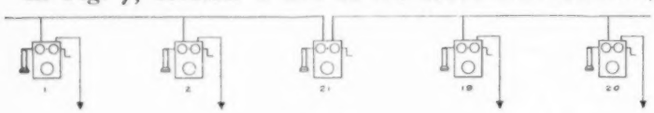


FIG. 7.

with No. 1 and No. 20, the end stations, No. 2 and No. 19, some of the bridging stations, and No. 21, the late addition to the circuit, in series, and which we are to presume is a 1600 ohm ringer.

Take an analogous case of a city water supply, as shown in Fig. 8, in which SP is the standpipe, furnishing constant pressure to a supply, requiring three foot mains. Let H1 and H2 be hydrants, separated from H3 and H4 by a two-inch pipe, which connects the three foot mains. It has been necessary to put in this two inch pipe on account of certain obstructions. It will not take a discussion of hydrostatics to show that if hydrant H1 is opened that a strong pressure is available. Also at H2, there will be a standpipe pressure.

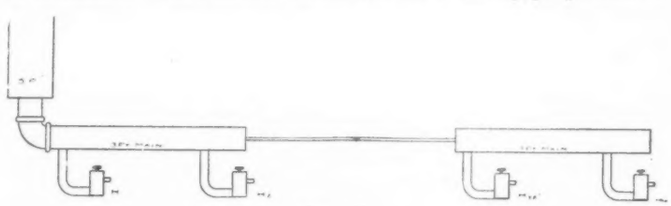


FIG. 8.

It is plain that if hydrant H3 is opened, and H4 as well, that there would be no water available, because the two inch pipe can not pass enough water, even for one hydrant.

Looking at Fig. 9, the 1600 ohm ringer is placed in the same position to the main line as is the two inch pipe. The main line is probably No. 12 iron, and the ringer of very fine wire, possibly carrying about one-twentieth of the current that the No. 12 does, or even much less. S1 and S2 are stations on one side of the 1600 ohm ringer, and S19 and S20 are stations on the other side.

In bridging ringing, it is a case of constant pressure, and variation of current. Suppose that station S1 turns the magneto handle. A pressure is generated, which is constant, and the number of bells rung is limited by the maximum current output of the generator, but leaving out of

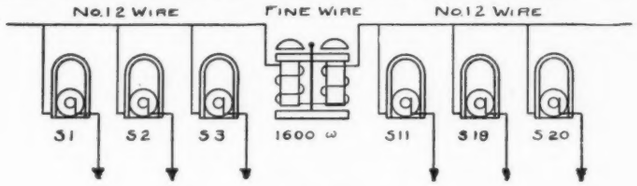


FIG. 9.

consideration output, the No. 1 generator will furnish ringing current to stations, from No. 1 to No. 10, because they are on the main line, and no small wire, or pipe, is in the way to reduce the current flow. But stations from No. 11 to No. 20, have to get all their supply through the small wire, which is not large enough to carry all the current necessary to ring the ten bells.

But let it be assumed that this 1600 ohm ringer is wound with wire large enough to carry all the current necessary. The real difficulty is explained by the fall of potential. Leaving out considerations of alternating currents, ten

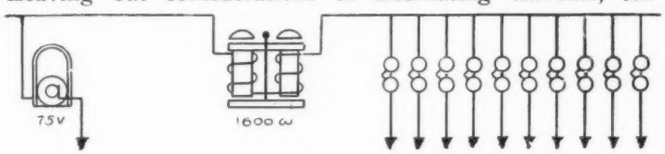


FIG. 10.

bells in parallel, 1600 ohms each, will have a total resistance of 160 ohms. Station No. 21 has 1600 ohms in series. The generator current has a pressure of 75 volts. According to Fig. 10, the 1600 ohms will consume ten-elevenths of the voltage, leaving but one-eleventh of 75 volts, or seven volts, to act on the ten bells on the other side.

If about seven volts remain to ring the ten bells, it is plain that there will not be very effectual ringing. If an eighty ohm series bell is placed at No. 21, there should not be

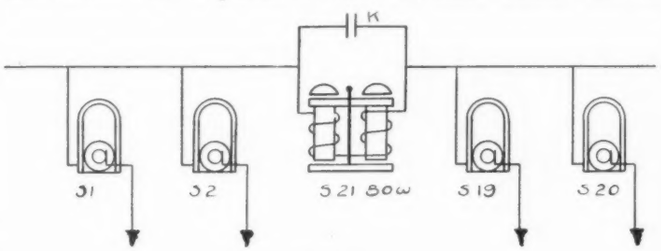


FIG. 11.

much difficulty in ringing all the twenty-one parties. If there was, a condenser placed in parallel with the bell will remedy the trouble, even with a bridging 1600 ohm ringer. This is shown in Fig. 11, in which K is the condenser.

Will No. 9 extra BB wire answer for 200-mile transmission, grounded system, equipped with good long-distance telephones? Our grounded system connects with the Richmond metallic system, sixty miles away, where there is an extensive electric power development, a part of which will parallel our lines five miles out of the city. Could we to an appreciable extent rid our lines of the disturbing influence of the electric lines by constructing, say, ten or twenty miles of metallic line from the city, and grounding, at that distance, our wire of the metallic line at the point of connection with our regular grounded line? We are familiar with the use of repeating coils, but it cuts down the talk so much that we cannot get good service on long lines. We are using this same method of connecting in the city of Charlottesville, only the connection is made in the city at the switchboard by grounding the metallic line when in use with ours, with no appreciable bad effects, though there is some electric power development there, but nothing to compare with Richmond; beside the lines do not parallel any distance.—C. E. J.

No. 9 iron wire might serve to give fair transmission over the two hundred miles with a limited number of bells, yet it is hardly reasonable practice to build grounded lines for such distances. A great many companies use iron wire for metallic lines not over twenty-five miles in length, but in these days of inductive disturbance in almost every village and hamlet, the grounded line is useless for service. The service advantages of a 200 mile toll line, purely metallic, would certainly offset the increased cost.

It is hard to believe that a sixty mile line, used as described, would not be unbalanced, and rendered too noisy for use. And even if no electric lines are in parallel, the act of grounding a line of that length at any place certainly throws it out of balance. It would do no good to run metallic out of the city and then ground, as unbalancing would result. A repeating coil in a great many cases is a help to transmission. A great many coils are designed for ringing through at the expense of transmission, and those that have been used may be of this kind. If there is any paralleling of electric power wires, it seems improbable that a metallic and a grounded line can be connected in any other manner.

However, conditions that hold good in one locality will not hold elsewhere. It would be interesting to know just how much noise this method of connecting will cause. It is all according to the service demanded by the subscribers. But in any case a toll line should be absolutely quiet, even at a slight expense of transmission.

It would seem more reasonable to build metallic out of Richmond for a short distance beyond the paralleling of power wires, an eighth of a mile, and put in a well-designed repeating coil, both for ringing and talking, and protect it securely from the weather.

Our switchboard is of multiple type, with three point jacks, tip, ring and sleeve. We are familiar with the ordinary method of locating crosses, that of dead points, or the place where the dynamo noise is not heard, but an ordinary lead-pencil point, which the operator has carelessly lost in the jack, does not show any dead point in the receiver, and will not betray itself under any conditions of receiver testing. Can you suggest a reliable test for lead-pencil points?—B. E. S.

For the benefit of those who do not know the ordinary method of testing jack crosses, reference is made to Fig. 12. J1, J2, J3, J4, J5, J6 and Jo are jacks of a multiple. Sup-

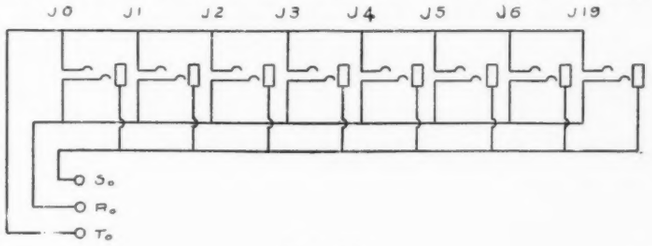


FIG. 12.

pose that a cross exists, which makes a permanent line signal in the common battery exchange. It is easy to assume that such a cross is between the tip and ring, or the main talking springs of the jack. Opening the line at To and Ro, and ringing on switchboard side, it is found that tip and ring springs are crossed. It remains for the switchboard man to locate the trouble exactly before touching the multiple. Reckless and frequent wedging of a multiple will put in more trouble than can be taken out in one day, and the opening of a multiple by a switchboard man to see if the trouble is clear up to that point should be punishable by jail sentence. In Fig. 13, the tip and ring of the crossed multiple springs are attached to the brushes of the power generator, which is usually from twenty to forty volts. In this connection is inserted a condenser to avoid a possible arcing at a partial cross from a high voltage. This con-

denser is lettered K. In the ordinary generator, if one would put a receiver across the terminals at TO and RO, the noise due to the dynamo would be distinctly heard in the receiver. To get contact on the tip and ring springs,

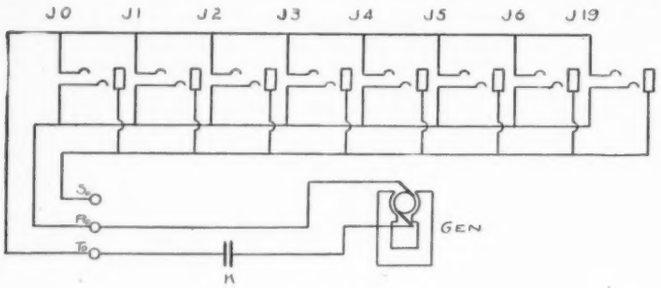


FIG. 13.

attach the receiver to the tip and ring terminals of the plug, according to Fig. 14, in which R is the receiver.

With the receiver to the ear, the man plugs into JO, and hears the dynamo noise nearly as plainly as at the brushes. So he goes to J1, and possibly might detect a falling off of the noise. Then he tries J2, and this time he is sure that there is some diminution of the noise. Passing on to J3 and J4, the noise falls off swiftly, and at J5 is heard

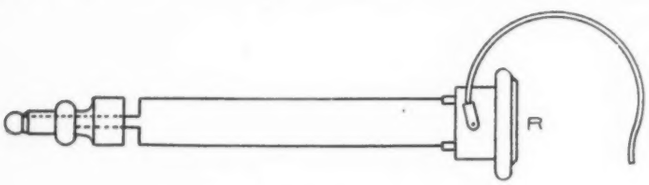


FIG. 14.

but very faintly. At J6, there is not a perceptible noise, and the switchboard man, knowing that the right jack has been found, wedges the multiple, and removes the offending part. Supposing that the man goes on to J7, J8, J9, and on to J19, it is claimed that the noise of the running dynamo commences to increase gradually, until at J19 the noise is heard as plainly as at Jo. This will be left to the reader to decide.

Supposing the cross to be between the tip and sleeve. This is usually determined beforehand by the fact that the cord lamp is unusually brilliant, and the cut-off relay refuses to act when a regular plug is inserted. This time the telephone is attached to the plug tip and sleeve ter-

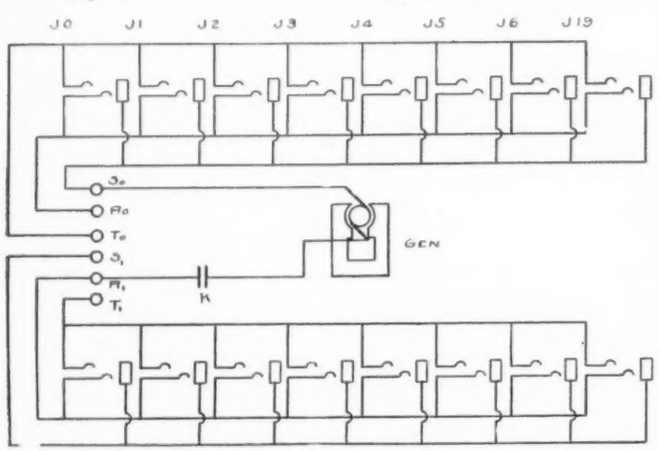


FIG. 15.

minals, and the dead point searched for. When the sleeve is crossed with the ring the fact may be readily learned by listening to the buzzing on the line. This is caused by the induction coil effect, between the cut-off relay and the line relay. To test, the receiver is attached to the ring and sleeve terminals of the plug.

If the sleeve of one jack touches the ring of another jack, a permanent line signal results, plain to the eye, and an open cut-off relay, which does not readily reveal itself. The one is readily discovered, and every switchboard man should suspect the other, which can be instantly proved by putting a short circuit plug in the jack of the suspected line, and endeavoring to bring in the line lamp signal. If it cannot be done, it is well to look at the cut-off relay, which will be found open. Opening and testing at So and R1, the magneto bell rings. Connect So and R1 to condenser and dynamo brushes, according to Fig. 15.

Connect, O, plug sleeve to receiver, and ring of plug, No. 1, as well. The dead point is found as readily as in former cases. Fig. 16.

The case of the lead pencil point presents a high resistance path, just enough to allow the relays to operate, yet a conversation can be carried on just as if the lead pencil point was absent. The listening test fails, because when the plug, with the telephone attached, is inserted in the jack where the pencil point is, its high resistance causes the sensitive telephone to act as if the jack springs were in open relation, and no diminution of noise is noticeable. If the operators could be induced to report the pencil accident, it

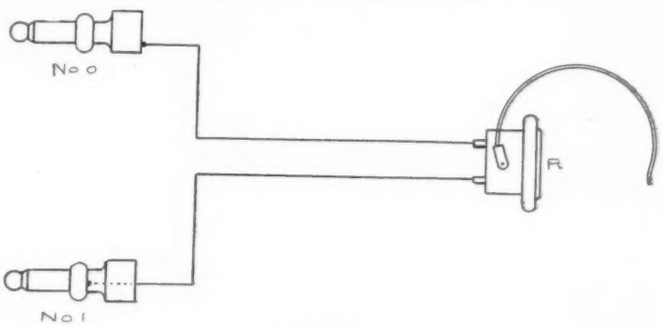


FIG. 16.

would save much trouble, but they will not admit it, in fear of a censure. Besides, they are not aware of doing it at times. Then they should not have lead pencils, but there are cases where it is very necessary. The next thing to try is to hold a piece of white paper under the jack, while a bent spring is carefully inserted in the jack, and whatever contents raked out on the paper. The pencil dust is easily recognizable, and the strip removed, the springs separated and the pencil point removed. All other tests seemed to be unreliable, and a waste of time. A good preliminary plan of locating a pencil cross is to plug in every jack in the multiple with just an ordinary answering, or calling plug, which will cause the lamp to be extinguished, just as if the party was with receiver off the hook. Somewhere along the jack, the act of plugging in a jack will not cause the cord lamp to be extinglished, because the entrance of the plug has separated the springs in such a manner as to clear the trouble, as long as a plug is in that particular jack. Going on to next jack, the lamp goes out upon the entrance of the plug, and it should be plain that the affected jack has revealed itself.

I am very anxious to know how, on a common battery system, when two telephones are connected over a trunk wire, does each telephone receive current from its respective central, or one station only?

I would like to get a diagram, showing two telephones, when connected by a trunk line, showing where each line gets its current, and if any current is on the trunk connecting the two? How is the connection made, and show whether one, two, or three batteries are used?

I would like also to get a diagram, showing how a telephone on a common battery system may be connected over a trunk line to a telephone of the magneto type. Length of trunk is four miles.—T. L. G.

There are several systems of common battery trunking, and each subscriber gets battery from his respective exchange. Nearly all systems have battery on the trunk line, which is the same battery that furnishes energy to the calling, or "A" subscriber. The "A" end of the trunk connection is a complete cord circuit, the answering plug inserted in the calling subscriber's jack, and the calling plug inserted in the outgoing trunk jack. The outgoing trunk jack may be said to end in the half of a repeating coil, attached to condenser terminals. The "B" end may be said to begin in the other half of this repeating coil, which is connected to the battery at the "B" station, and end in the called subscriber's station. Two batteries, which will be lettered B1 and B2, will be the respective batteries belonging to the "A" and "B" party respectively.

The connection is made by means of an order wire, which is connected to all the "A" operator's telephones by means of buttons, which when depressed put the telephone set in communication with the operator "B," who sits at the incoming trunk position. The "A" party calls, and asks for a number in the branch office. The "A" operator depresses the order button, says to the "B" operator, "500." The "B" operator responds, saying, "On three," meaning for the "A" operator to insert her calling plug into the jack of outgoing trunk No. 3. Whereupon the "B" operator rings the party called for, relieving the "A" operator of that duty. The ringing is done by the "B" operator, and if the signal shows that the party called does not answer, she puts the trunk plug into what is called the "busy back" jack, which gives a tone to the party waiting at "A" end, and a flashing of the supervisory lamp to the operator, who then breaks in, and tells the party that the line he wants is busy, or that they don't answer, according to the speed of the flashing.

In the standard trunk circuit, an ordinary conversation between two parties involves four supervisory signals. The first two are the answering and calling lamps in the "A" exchange, and the other two are in the "B" exchange. They are called the ringing lamp and the disconnect lamp. The ringing lamp signifies to the "B" operator, who is a dummy operator, when the party answers, and saves the possibility of ringing on a talking connection. The disconnect lamp is the one which signifies to "B" operator that the "A" operator has plugged into the proper trunk, and which assures her that she can ring the party, without danger of no connection, and the signals refusing to work properly. When the parties have both hung up, both signals at "B" are still dark. The ringing lamp has gone out to stay out during that one connection. The lighting of the disconnect lamp signifies to "B" that she may pull down the connection. Therefore, it may be said that the "B" operator puts up a

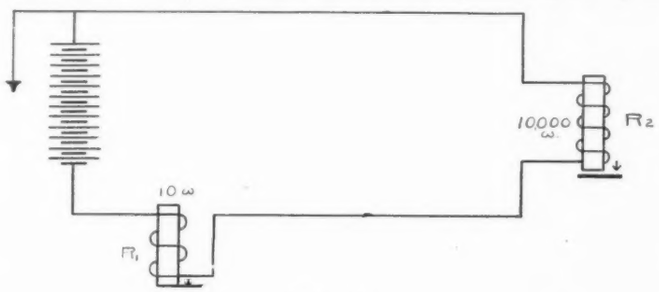


FIG. 17.

connection by verbal order, and pulls down the cord only on mechanical order. The "A" operator is responsible for the connection, as there is a law of good service that the originating operator shall watch the connection through its entire issue. The "B" operator acts only upon orders from "A".

The prevailing principle in trunk design takes advantage of the extremes of resistance through which a relay will operate at a pressure of twenty volts. The ordinary relay has a standard working resistance which is seven hundred and fifty ohms. If a resistance is placed in the trunk circuit of any resistance under this amount, the relay belonging to the "A" cord circuit will close its contacts, and extinguish the lamp.

If, according to Fig. 17, a ten thousand ohm relay is placed in series with the battery and a relay which is supposed to belong to the "A" cord circuit, it will be seen that R2 will close its contacts, but R1 will not be affected, because it can not get enough current either to pull up its contacts, or to hold them up when once pulled up. R2 belongs to the "B" end, and controls the disconnect signal, which is done without operating R1.

According to Fig. 18, R3 belongs to the "B" circuit, and is the relay which acts when the subscriber removes his telephone from the hook. When R3 acts, it brings a small resistance about the high ten thousand ohm resistance, with-

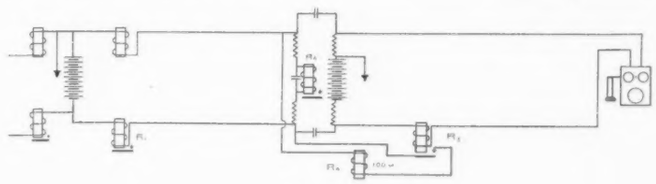


FIG. 18.

out causing its magnetism to be weakened, and adds a phase to the case. The one hundred ohms in the "A" circuit makes the relay R1 operate at the same time that R3 does, so it is possible for the "A" operator to see that the party has answered at the same time that "B" sees it.

Fig. 19 shows the skeleton sketch of a trunk circuit, with R1, the relay governing the "4A" calling lamp, R2, the relay governing the disconnect lamp at "B", R3 governing the action of the subscriber removing his receiver, and the ringing lamp, R4, the relay governing the locking out of the ringing lamp, and R5, the relay governing the original

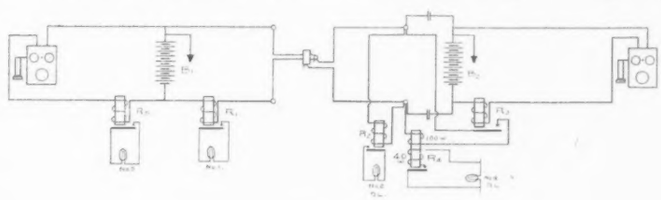


FIG. 19.

"A" calling party. Party calls, and "A" answers. Relay R5 extinguishes lamp No. 5. "A" depresses order button, and "B" assigns trunk number. "A" plugs in, and lamp No. 1 is lighted. "B" plugs in at her exchange multiple, and the lamps No. 2 and No. 4 are lighted. But the act of "4A" plugging in has acted on R2, and has extinguished lamp No. 2. Then "B" rings, and when the party answers, lamps No. 1 and No. 4 are extinguished. All lamps are out.

Suppose that the office boy at "B" end has hung up, after calling the man to his extension set. Lamp No. 4 will not light, because it has been locked out. Lamp No. 1 will light, but the "4A" operator does not pull down on one lamp, so the connection will not be taken down. "B4" knows nothing of this, and does not touch the connection. After the conversation is finished, both parties hang up, lighting lamps No. 1 and No. 5. Lamp No. 5 is lighted, because the "A" subscriber has hung up, and No. 1 lights up, because the relay R3 has removed the hundred ohm winding of relay R4 from parallelism with the winding of R2. The relay R1 cannot retain its contacts with the current that would flow through it with ten thousand ohms in the circuit. When lamp No. 1 lights up, "A" pulls out plug, and relay R2, having no source of current supply,

falls back, and allows No. 2 lamp to light, and gives the "B" operator notice to pull down the plug.

This is but a bare outline of a common battery trunk. There are several systems, some using condensers, others repeating coils, and as T. L. G. has not asked the system that he wants described in particular, none will be given in detail.

In regard to a trunk between a common and local battery system, it is well to state at the start that telephone systems of unlike nature should only be in inductive relation, that is, separated by a repeating coil. An order wire trunk to a common battery exchange should have the locking features of the pure common battery trunk. The disconnect lamp

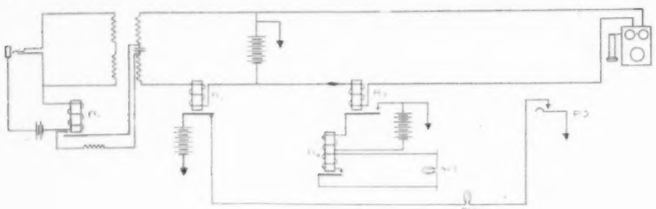


FIG. 20.

and the ringing lamp is employed, and the disconnection of the trunk plug depends upon the withdrawal of the "A" plug. In trunking from a local to a common battery exchange, the local battery cord circuit does not have battery existant. So the high resistance relay is dispensed with, and the arrangement made according to Fig. 20.

R1 is the relay of the trunk at the "A" end, which is actuated by the entrance of the operator's plug. The sleeve of the plug will short circuit the sleeve and the ring spring of the jack, and cause a local battery to flow through R1. Its contacts close about the condenser R. R2 is a non-inductive relay, with back contacts. R3 is the cord relay, and R4, the locking relay. Ps is a plug switch, which closes contacts when the plug is raised from its socket.

"A" local battery party calls, and asks for a common battery party. "A" depresses order button, and is assigned to a trunk. "B" picks up the plug of that trunk, and tests. This lights lamp No. 1. The act of "A" in plugging in has caused battery to flow through R2, which extinguishes lamp No. 1. The insertion of the "B" plug has lighted lamp No. 2. When the party answers, R3 is actuated, and causes battery to flow through relay R4, and closes contacts about lamp No. 2. This contact closes a live winding of forty ohms, if the system uses shunting methods, around the lamp, and puts it out. And it stays out until used again. This is a slow method, becase it takes a local battery originating operator longer to supervise, and "B" gets a disconnect some time after the party has gone, through relay R2 being released, and lighting lamp No. 1.

As a particular system has not been asked for, only the bare operating action of the relays can be shown.

Convention of the Northwestern Cedarmen's Association.

The seventh annual convention of the Northwestern Cedarmen's Association was held at the West Hotel, Minneapolis, on January 12, and was one of the most important and best attended conventions in the history of the organization. The meeting was called to order by President C. H. Worcester and Secretary J. H. Gilman read the minutes of the last annual meeting, also the minutes of an adjourned meeting, which were approved.

President Worcester announced that owing to press of business he had been unable to prepare an address. He referred the review of the work accomplished the past year to the secretary, who said in his annual report:

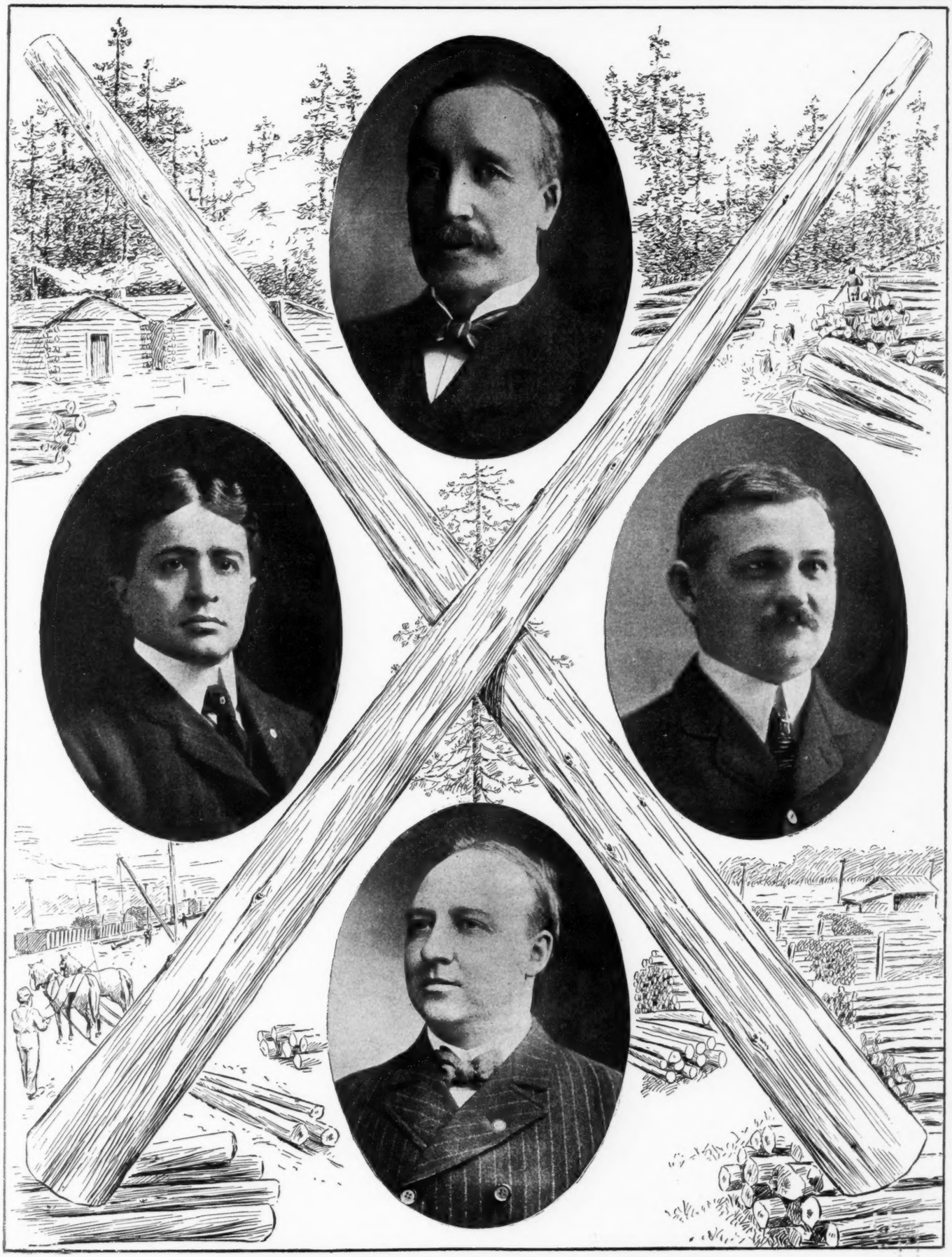
It is appropriate at this time to briefly review the cedar trade situation as it has been during the past year. A year ago at our meeting at Menominee, our president in closing his annual address, said he hoped that our members would experience during the year 1902 a season as prosperous as that of 1901. You who are present here to-day know how much his hopes have been realized. There are probably some of you who feel that you have not realized your expectations during the past twelve months. I particularly refer to those who handle poles. For some unexplainable reason, poles were not in as good demand last year as the prosperous condition of general business would warrant. The large consumers of poles, among the telephone, telegraph and other electrical companies, seemed to curtail operations in a way to cut off the demand for poles, perhaps with the object in view of showing up larger dividends to their stockholders.

The producers and handlers of posts and shingles, however, particularly posts, had no cause to complain of the trade they have enjoyed the past year. Not long after our last annual meeting in Menominee in January, when work in the woods was being rushed, and it looked as if a large stock of cedar posts would be gotten out, there came a break in the weather earlier than usual and the supply of posts for the year was somewhat curtailed. You know how firm the post situation is to-day. Stocks up to 20-foot lengths are very light and the demand promises to be equally as good the coming year as it has been the past. Our members who manufacture shingles have to contend with competition of the red cedar shingles from the Pacific coast. With perhaps one exception it has controlled the price of white cedar shingles. During the summer of 1901, however, when West coast shingles took a big slump, the white cedar market was not appreciably affected and white cedar shingles steadily advanced until the beginning of 1902 and continued quite firm until last spring, when the red cedar shingle market again went off and our shingles followed suit. With the increased cost of producing cedar, both posts and poles and shingle bolts, it is necessary that cedarmen accordingly guard the margin between producing and selling that it may not disappear altogether.

I will refer more particularly to the work of our association, as viewed from the secretary's office. During the past year our association has prospered materially, as is shown by the increase in our membership, and in the fact that the members we are now securing are all a credit to our association. A year ago at our annual meeting, we had sixty members and four new members joined at that time. We lost one member during the year by resignation, and we have dropped the name of one from our membership list, owing to non-payment of dues, making a total loss of two members. We have gained fifteen new members during the year, making a net gain of thirteen, and our total membership to-day is seventy-three. The following have joined our association at and since our last annual meeting:

I. Stephenson Co., Wells, Mich.
E. E. Naugle Tie Co., Chicago, Ill.
Chicago Lbr. & Coal Co., Minneapolis, Minn.
Francis Biedler & Co., Chicago, Ill.
T. M. Partridge Lbr. Co., Minneapolis, Minn.
Scott & Taylor, Ashland, Wis.
Kellogg Switchboard & S. Co., Escanaba, Mich.
Wisconsin Timber & Land Co., Mattoon, Wis.
Cloquet Tie and Post Co., Cloquet, Minn.
Samuel C. Jackson Co., Tenstrike, Minn.
A. E. Whitmore, Minneapolis, Minn.
Fowler-Jacobs Co., Chicago, Ill.
Hall L. Brooks, Tomahawk, Wis.
D. A. Haneman, Earlville, Ill.
Hughes-Mackintosh Co., Minneapolis, Minn.

With efficient work upon the part of your secretary, I believe that it will not be in the far distant future when our membership roll will number the names of over one hundred representative handlers of white cedar products. The increase in membership is not so much due to the public getting the idea that the cedar business is a snap and an easy one in which to make money, but to the recognition of the merits of our association by those who have been some time engaged in it and who wish to join forces with us in carrying on the good work.



OFFICERS NORTHWESTERN CEDARMEN'S ASSOCIATION.

R. H. DOWNING, PRESIDENT.

FRED. H. GILMAN, SECRETARY. WM. MUELLER, JR., VICE PRESIDENT, H. W. READE, TREASURER.

The changes that were made in the eligibility clause in the constitution at our last annual meeting have been proved by experience to be wise. As the association is primarily a selling organization, it is but proper that its members should be confined to those who are selling to the trade direct in car-lots, and this has been borne in mind in considering applications during the past year, with the result that some applications have been rejected, although coming from concerns of good standing, and who, no doubt, would be an honor to our association were the nature of their business different.

While our expenses during the past year have been quite large for postage, printing, etc., it was due largely to the issuing of freight classification books, which I believe, however, have been appreciated by our members who sell to the retail trade and who have occasion to frequently look up rates to many small points. Unfortunately, the rate situation became unstable soon after the books were issued, and at present they cannot be relied upon, and should be revised. The expenses we have been to have resulted in reducing the usual surplus we have in the treasury at the end of each year, so that it was deemed best by our directors to not have the usual banquet this time, but we believe that the entertainment we have arranged for to-night, while less expensive, will please you just as well.

I believe this marks a point in the history of our association where it is to become more of a business organization. Its influence is now very large and it is recognized by the trade generally, and its specifications, official weights, etc., have a standing throughout the country. The railway weighing association are more and more depending upon our official weights in the settlement of claims. This is an important point gained.

Many of you gentlemen were present at the meeting held at Menominee on January 28th, 1898, at which time the association was reorganized and put upon a firm footing. At that time, you will remember, the cedar industry was not in as prosperous a condition as it is to-day. To be sure, much of the change for the better that has occurred has been due to a general improvement in business conditions, but yet can we not attribute a considerable of it to the organized effort of the Northwestern Cedarmen's Association? I believe we can. It has aimed to establish uniformity. It has established specifications that are recognized by the buying trade everywhere. It has established official weights, and it has brought to the railroad freight officials the recognition of the fact that the cedar industry is one of the important industries of the northern country. It has been customary at these meetings to refer to the rather ragged and demoralized class of people that once called themselves cedar men, and compare them with the prosperous and well-fed individuals we see around us at this meeting to-day. There is more truth than fiction in these comparisons, and I believe that the Northwestern Cedarmen's Association should be given credit for having helped to bring about this change.

SCENE IN THE WOODS AT PENDLETON & GILKEY'S CEDAR CAMP, MOUNTAIN, WIS.

During the past year, the work of your secretary has moved along very smoothly. The matter of recommending changes in post and shingle prices has been attended to by the post and shingle committee without the necessity for a general meeting. In fact, last year was the first year during which no meeting except the annual was held. This indicates that the machinery of our association is now in good working order. Then, too, the markets during the past year was such that it was deemed unnecessary to make any radical changes in prices recommended, or in other matters. That our association is being recognized by the buying trade is evidenced by the applications received at the secretary's office for price lists by retail dealers and large line yard concerns, and also for specifications and other matters of this nature. Because of this, your directors deemed it advisable to instruct your secretary to charge a nominal sum for price lists and classification books to non-members of the association, and as a result, we have received a small income from this source. There have been few complaints during the past year, or disputes as to specifications reported at this office, but as to this, your inspection committee will report undoubtedly more in detail.

PROMINENT PRODUCERS AND DEALERS IN CEDAR PRODUCTS.

W. P. Bowring.
W. C. Church.
M. H. Coolidge.
F. H. Chandler.
M. B. Cross.
C. B. Brooks.
L. F. Chapman.
A. E. Darling.
W. J. Carney.
E. L. Clark.
W. J. Davis.

In closing I would suggest that the association could be made still more valuable to its members if they would report to the secretary two or three times a year, the amount of stock they have on hand, in order that the totals might be compiled and used in the future for comparative purposes, and in this way a better and

A FIFTY FOOT CEDAR POLL JUST FELLED.

clearer understanding of the trade situation could be obtained by our members. No attempt was made last year to collect data of this nature, as the effort made the year previous was unsuccessful, only about one-third of the members reporting. This information given to your secretary would be seen by no one else, and the totals when reported to you would be of considerable value to you, particularly after data had been obtained for two or three continuous years.

In conclusion I would thank the members for the assistance they have rendered the secretary during the past year and the patience they have exercised with his shortcomings.

H. W. Reade, treasurer of the association, then presented

TYPICAL WINTER SCENE IN CEDAR YARD.

his statement of the financial condition of the association, which was as follows:

January 7, 1902, balance on hand	$580.42
Received from interest, fees and dues	905.00
Received from selling classification books and lists	17.55
Total	$1,502.97
Disbursements	1,424.71
Balance on hand Jan. 12, 1903	$78.26

This report was also approved by the association and ordered placed on file.

Secretary Gilman then announced a smoker at the Minneapolis Commercial Club at 8:30 p. m., to which all were invited. After the announcement F. J. Lang was called upon for the report of the post and shingle committee and presented the recommended selling prices as follows:

MIXED CARS, POSTS AND POLES.

Dia.	Inches.	Length.	Price.	Dia.	Inches.	Length.	Price.
3	R	7	7½ cts.	5	R	12	33 cts.
4	"	7	11 "	6	"	12	36 "
5	"	7	13½ "	7	"	12	41 "
6	"	7	14 "	4	"	14	30 "
7	"	7	16 "	5	"	14	38 "
8	"	7	25 "	6	"	14	41 "
5	½	7	7½ "	7	"	14	48 "
6	"	7	8½ "	4	"	16	40 "
7	"	7	9½ "	5	"	16	45 "
7-9	¼	7	7 "	6	"	16	50 "
4	R	8	15 "	7	"	16	58 "
5	"	8	17 "	4	"	18	55 "
6	"	8	19 "	5	"	18	62 "
7	"	8	22 "	6	"	18	72 "
8	"	8	35 "	7	"	18	85 "
4	"	10	21 "	4	"	20	65 "
5	"	10	28 "	5	"	20	80 "
6	"	10	30 "	6	"	20	90 "
7	"	10	35 "	7	"	20	$1.05
8	"	10	58 "	4	"	25	80 "
4	"	12	25 "	5	"	25	1.00
				5	"	30	1.50

TABLE OF WEIGHTS.

4	inch, 20 foot,	100 pounds	6	inch, 40 foot,	625 pounds
5	inch, 20 foot,	130 pounds	7	inch, 40 foot,	800 pounds
4	inch, 25 foot,	150 pounds	6	inch, 45 foot,	835 pounds
5	inch, 25 foot,	200 pounds	7	inch, 45 foot,	1000 pounds
6	inch, 25 foot,	250 pounds	6	inch, 50 foot,	1035 pounds
7	inch, 25 foot,	350 pounds	7	inch, 50 foot,	1250 pounds
5	inch, 30 foot,	275 pounds	6	inch, 55 foot,	1300 pounds
6	inch, 30 foot,	350 pounds	7	inch, 55 foot,	1550 pounds
7	inch, 30 foot,	450 pounds	7	inch, 60 foot,	2000 pounds
6	inch, 35 foot,	450 pounds	7	inch, 65 foot,	2700 pounds
7	inch, 35 foot,	600 pounds	7	inch, 70 foot,	3400 pounds

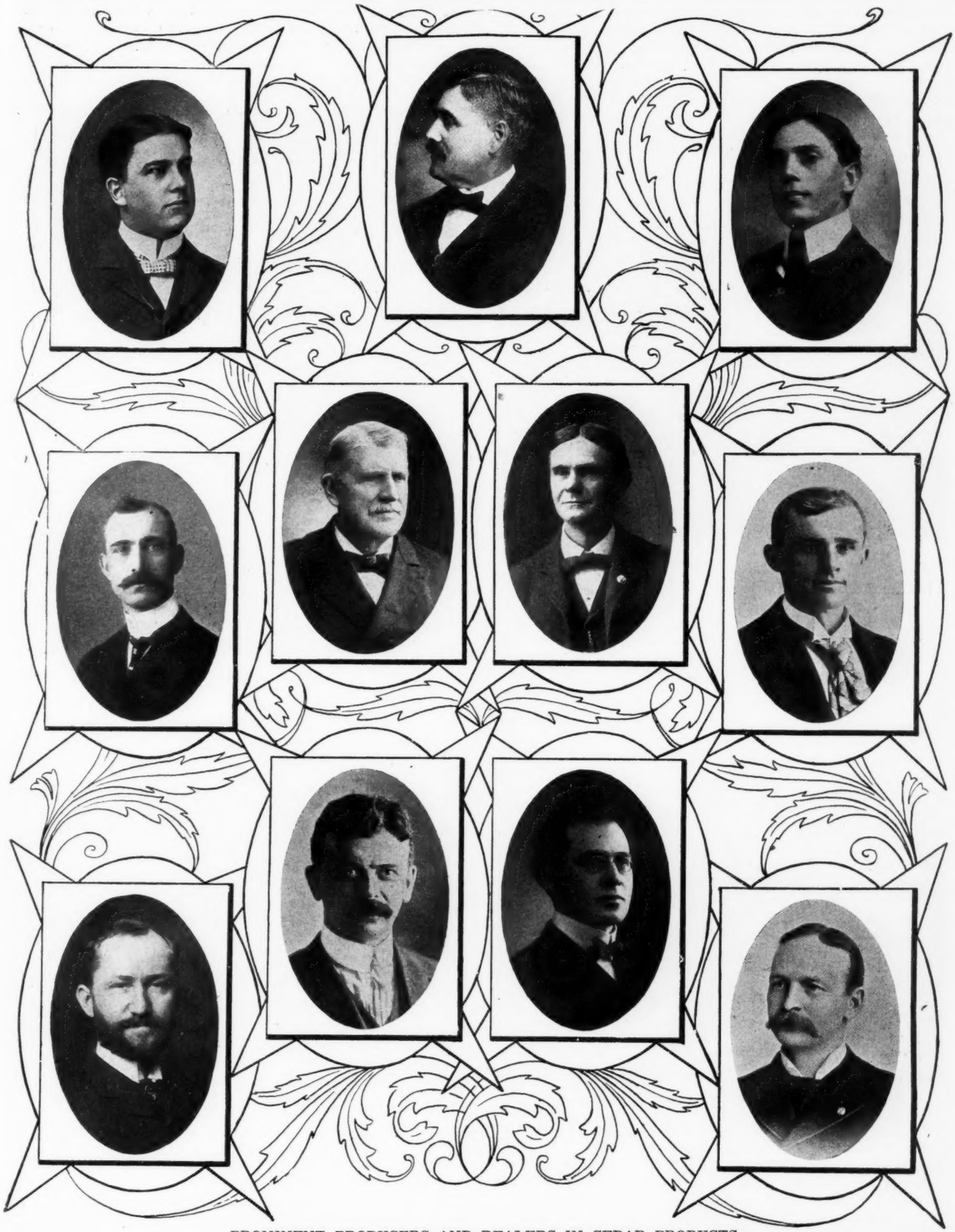
G. L. Lindsley, chairman of the pole committee, reported that the committee had been unable to agree upon a pole price list so had no formal report to make. This left the matter as it had been before the meeting. This report provoked some discussion. For several years the pole

SKIDWAY OF POLES IN THE WOODS.

members have adopted no official list price and the post men have felt that they have not been treated quite right in the matter, claiming that pole men learn of their post prices, whereas they do not reciprocate.

Mr. Bruett spoke along these lines, asking that the pole committee be requested to make some report that the post men might have an idea of the pole price situation.

At this point President Worcester called Mr. Downing,



PROMINENT PRODUCERS AND DEALERS IN CEDAR PRODUCTS.

J. H. Fowler. H. S. Gilkey. E. E. Kaufman. W. H. Holcomb. J. C. Kirkpatrick. D. M. Fulmer. C. C. Houston. F. J. Lang. J. W. Fulmer. J. A. Jacobs. J. P. Lansing.

vice-president of the association, to the chair in his place, stating that as he was a large handler of poles he would rather that some one more neutrally inclined be in the chair.

A. T. Naugle moved that the report of the pole committee be adopted.

Speaking on this motion Mr. Worcester said that the matter of pole price had always been a bone of contention in the association. Personally, he said his interests were mixed, as he was a large handler of both poles and posts.

EMPLOYES IN A CEDAR CAMP.

When he sold poles he naturally wished to see prices maintained, but when he went into the woods to buy he would rather not have a published list price.

Mr. Bruett talked further on the subject and said that as soon as the meeting was over the trade would at once know the prices recommended for posts, but they would have no knowledge of the pole situation. This he thought was one-sided and unfair to the pole men. Several pole men were called upon for their views in the matter, but declined to say anything.

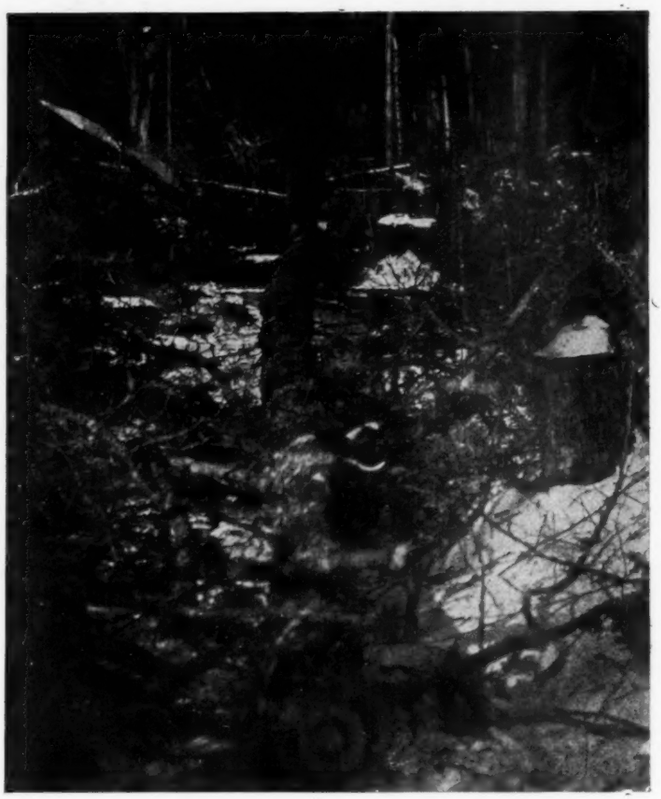
Mr. Robinson called attention to the fact that many post men sold poles to the trade and if they had a list on which to base prices they would be better posted and would not be likely to injure the pole trade.

CEDAR JOBBERS' CAMP, NORTHERN MICHIGAN.

Mr. Gilkey said he could not see how the pole men could be forced to show their hands. Said he:

If you appoint a new committee and want intelligent men, you must appoint pole men. (Laughter.) They are good fellows, we like to see them with us, and if they want to pay their money and make no report, I think it is all right.

A. T. Naugle remarked that posts were all sold on the same specifications, while poles were sold on so many different specifications that it was impossible to make a price list apply to all. Mr. Cross thought that it would be best to make a pole list to apply to the association inspection, but



A FORTY-FIVE FOOT CEDAR POLE PARTIALLY TRIMMED.

Mr. Naugle did not think this would be practicable. This ended the discussion and the report of the pole committee was adopted.

Mr. Worcester then resumed the chair and appointed the following nominating committee: H. S. Gilkey, F. J. Lang and G. L. Lindsley. A short recess was then taken while the committee prepared its report. When the meeting again convened Chairman Gilkey of the nominating committee reported recommending the following officers for the association for the ensuing year:

President—R. H. Downing, Minneapolis, Minn.

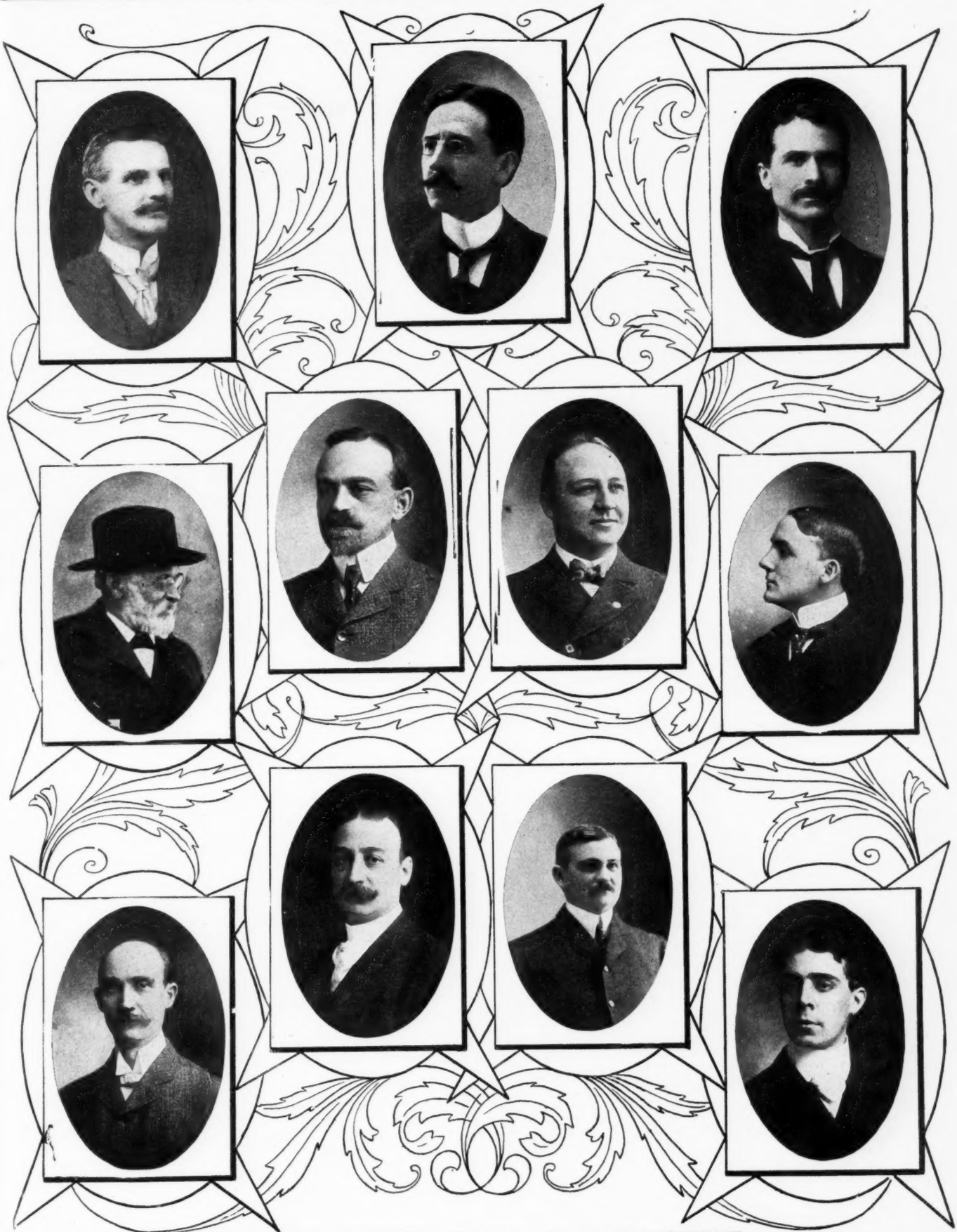
Vice-president—William Mueller, Jr., Chicago.

Directors—C. H. Worcester, Marinette, Wis.; G. L. Lindsley, Chicago; George Nicholson, Jr., Manistique, Mich.; H. S. Gilkey, Minneapolis, Minn.

The officers and directors as nominated were unanimously elected.

Mr. Downing, on taking the chair as president of the association and being called upon for a speech, thanked the members for the honor they had conferred upon him. He referred to the little pole discussion that has just been ended and said that he believed that the association was now stronger than any faction in it; that the majority would prevail and that it would continue to do good work for those interested in the cedar industry. In conclusion he said that he would try during the coming year to treat all fairly and carry out a business administration.

Some further discussion of the pole matter was brought up by Mr. Cross, who suggested that when the new pole committee should be appointed it be instructed to confer with the companies having different inspection and request them to agree upon a uniform specification for poles.



PROMINENT PRODUCERS AND DEALERS IN CEDAR PRODUCTS.

W. G. Liggett.
Wm. Mueller, Sr.
E. E. Naugle.
G. L. Lindsley.
G. M. Mashek.
F. W. Raber.
Wm. Mueller, Jr.
H. W. Reade.
J. P. McGoldrick.
A. F. Naugle.
H. C. Reynolds.

E. H. Valentine was asked to speak on the subject and he said that the pole men were merchants and had something to sell; that the electrical companies were buyers and it would not be possible for the sellers to dictate to the buyers in the matter of specifications as their needs were different.

Mr. Cross said that he understood that the Independent lines were adopting the Northwestern Cederman's Association specifications and he thought it might be possible to induce the Postal Telegraph, Western Union and other large users to do likewise.

Regarding this, Mr. Worcester said that the needs of the different companies differed as to specifications and that the specifications were frequently changed at the will of the chief engineers so that it would be impossible for the sellers of poles to dictate in this matter.

Mr. Lindsley called attention to a discrimination in freight rates in favor of the northern Minnesota producers of cedar against the northern Wisconsin and Michigan producers in shipping into the territory southwest of Minneapolis and suggested that the railroad committee look into the matter.

This concluded the business of the convention, which was without doubt the most successful one ever held by the association.

President Downing shortly after the conclusion of the meeting prepared and announced the standing committees for the ensuing year as follows:

Posts and Shingles—F. J. Lang, Hermansville, Mich., chairman; W. B. Thomas, Manistique, Mich.; H. S. Gilkey, Minneapolis; O. Erickson, Escanaba, Mich.; Daniel MacGillis, Milwaukee, Wis.

Poles—C. H. Worcester, Marinette, Wis., chairman, M. H. Coolidge, Minneapolis; J. C. Kirkpatrick, Escanaba, Mich.; William Mueller, Jr., Chicago; E. H. Valentine, Chicago.

Official Inspection—William Mueller, Jr., Chicago, chairman; Hall L. Brooks, Tomahawk, Wis.; J. K. Wright, Marinette, Wis.; H. W. Reade, Escanaba, Mich.

Railroads—E. E. Naugle, Chicago, chairman; J. C. Kirkpatrick, Escanaba, Mich.; W. T. Watkins, Minneapolis.

A meeting of the newly elected board of directors was held following the conclusion of the convention at which some routine matters were attended to, and W. H. Reade and Fred H. Gilman were re-elected treasurer and secretary, respectively, of the association for another year.

The membership of the association January 12, 1903, was as follows:

IDAHO.

Sand Point—Humbird Lumber Company.

ILLINOIS.

Chicago—Edward Hines Lumber Company, Lincoln street, south of Blue Island avenue.
Holcomb-Lobb Company, 746 Marquette building.
William Mueller Company, 1211 Marquette building.
W. C. B. Palmer, 1172 South Robey street.
Carney Bros. Company, 610 Chamber of Commerce.
Raber & Watson, Old Colony building.
Valentine-Clark Company, 805 Gaff building, 234 La Salle street.
O. W. Smith, 840 Temple Court building, 225 Dearborn street.
John H. Fowler, 1705 Fisher building.
Fowler-Jacobs Company, 1705 Fisher building.
Perley Lowe & Co., 1518 Monadnock building.
Francis Beidler & Co., Twenty-second and Loomis streets.
E. E. Naugle Tie Company, 135 Adams street.
Lindsley Bros. Company, 536 Tribune building.
Earlville—D. A. Hapeman.
Rockford—Woodruff & Maguire Company.

MICHIGAN.

Au Sable—H. M. Loud's Sons Company.
Bovee—Bovee, Robinson & Co.
Daggett—Perrizo & Sons.
Escanaba—Erickson & Bissell.
A. P. Hopkins & Co.
Pittsburg & L. S. Iron Company.
Mashek & Arnold.
J. E. Reinger.
Kellogg Switchboard & Supply Company.
Engadine—A. D. Day & Co.
Hermansville—Wisconsin Land & Lumber Company.
Ingalls—Ira Carley.
Manistique—White Marble Lime Company.
Menominee—Harding Shingle Company.
C. J. Huebel Co.
Wolverine Cedar & Lumber Company.
Nadeau—Nadeau Bros.
Perronville—M. Perron.
Pembina—A. W. Brandt.
G. Harter & Son.
Spaulding—Ross Bros. & Co.
Vulcan—O-C. Lumber Company.
Wells—I. Stephenson Company.

MINNESOTA.

Cloquet—Cloquet Tie & Post Company.
Duluth—L. R. Martin, 11 Fifth avenue, West.
Minneapolis—Minneapolis Cedar & Lumber Company.
Bradley-Watkins Company.
W. T. Reynolds.
Marshall Coolidge Company.
McGoldrick Lumber Company.
Chicago Lumber & Coal Company.
Pendleton & Gilkey.
T. M. Partridge Lumber Company.
A. E. Whitmore.
Hughes-Mackintosh Company.
Tenstrike—Samuel C. Jackson Company.

OHIO.

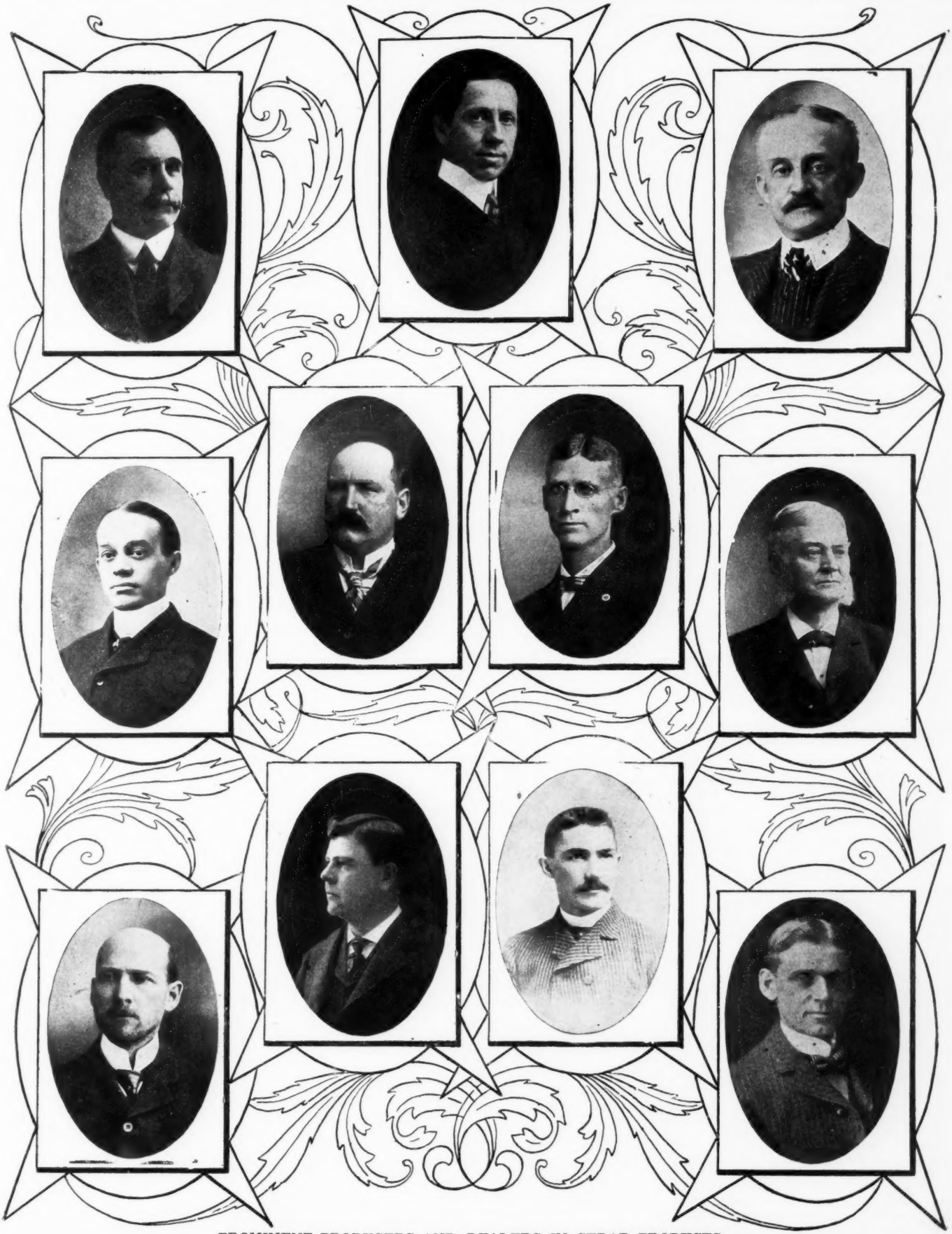
Cleveland—Cleveland Cedar Company.

WISCONSIN.

Ashland—Scott & Taylor.
Cumberland—Beaver Dam Lumber Company
Clintonville—Torrey Cedar Company.
Florence—D. M. Fulmer Lumber Company.
Green Bay—H. E. Leaper.
Marinette—Wright Bros.
C. H. Worcester Company.
Davis & Stitt Company.
Hamilton & Merryman Company.
Madison—Parkinson Cedar Company.
Brittingham & Hixon Lumber Company.
Mattoon—Wisconsin Timber & Land Company.
Milwaukee—MacGillis & Gibbs Lumber Company.
Wilbur Lumber Company.
Oconto—Holt Lumber Company.
Oshkosh—The Morgan Company.
W. J. Wagstaff.
Sanborn—M. O. Hallack.
Tomahawk—Hall L. Brooks.

The following is a list of the members and guests present at the convention:

Bennett, E. M. ..... Chicago
Bissell, M. K., Erickson & Bissell ..... Escanaba, Mich.
Bowring, W. P., C. H. Worcester Company ..... Marinette, Wis.
Brandt, A. W. ..... Faithorn Junction, Wis.
Brooks, C. B., Marshall H. Coolidge ..... Minneapolis
Brooks, J. M., Marshall H. Coolidge ..... Minneapolis
Brooks, Hall L. ..... Tomahawk, Wis.
Bruett, T. A., Wilbur Lumber Company ..... Milwaukee
Chandler, F. H., Marshall H. Coolidge ..... Minneapolis
Chapman, L. H., Holcomb-Lobb Company ..... Marinette, Mich.
Church, W. C., Scott-Church Company ..... Des Moines, Ia.
Clark, E. L., Valentine-Clark Co. ..... Chicago
Coolidge, Marshall H. ..... Minneapolis
Cross, M. B., Francis Beidler Lumber Co. ..... Chicago
Darling, A. E., Chicago Lumber and Coal Company ..... Minneapolis
Downing, R. H., Bradley-Watkins Company ..... Minneapolis
Erickson, O., Erickson & Bissell ..... Escanaba, Mich.
Fowler, John H., Fowler-Jacobs Co. ..... Chicago
Fulmer, J. W., D. M. Fulmer Lumber Company ..... Florence, Wis.
Gerich, J. E., MacGillis and Gibbs Lumber Company ..... Milwaukee
Gilkey, H. S., Pendleton & Gilkey ..... Minneapolis
Gilman, Fred H., American Lumberman ..... Minneapolis
Griffin, R. A. ..... New York
Hayden, J. T., Mississippi Valley Lumberman ..... Minneapolis
Huebel, C. J., C. J. Huebel Company ..... Menominee, Mich.
Jacobs, John A., Fowler-Jacobs Co. ..... Washburn
Kaufman, E. E., Carney Bros. Company ..... Chicago
Kirkpatrick, J. C., Pittsburg and Lake Superior Iron Company ..... Escanaba, Mich.
Lang, F. J., Wisconsin Land and Lumber Company ..... Hermansville, Mich.
Lansing, J. P., Hughes-Mackintosh Company ..... Minneapolis
Lindsley, G. L., Lindsley Bros. Company ..... Chicago
Martin, L. R. ..... Duluth, Minn.
Mashek, George ..... Escanaba, Mich.
McGoldrick, J. P., McGoldrick Lumber Company ..... Minneapolis
MacKenzie, W. R., Brettingham & Hixon Lumber Co. ..... Madison, Wis.
McMeal, H. B., Telephony ..... Chicago



PROMINENT PRODUCERS AND DEALERS IN CEDAR PRODUCTS.

W. T. Reynolds.
W. C. Sterling, Jr.
B. F. Vreeland.
O. W. Smith.
W. J. Stitt.
T. P. Wall.
W. W. Townsend.
A. D. Watson.
W. C. Sterling.
E. H. Valentine.
C. H. Worcester.

Miller, J. P., Minneapolis Cedar and Lumber Company..Minneapolis
Mock, Ed J., Telephony .....Chicago
Mueller, William, Jr., William Mueller Company.....Chicago
Naugle, A. T., E. E. Naugle Tie Company.....Chicago
Naugle, E. E., E. E. Naugle Tie Company.....Chicago
Nicholson, George, Jr., White Marble Lime Company.....
..... Manistique, Mich.
O'Callaghan, Jas., O-C. Lumber Company.....Vulcan, Mich.
Partridge, H. F., T. M. Partridge Lumber Company....Minneapolis
Partridge, T. M., T. M. Partridge Lumber Company....Minneapolis
Perrizo, Ed., Perrizo & Sons.....Daggett, Mich.
Perron, M. .....Perronville, Mich.
Reade, H. W., Pittsburg and Lake Superior Iron Company....
..... Escanaba, Mich.
Reynolds, W. T.....Minneapolis
Reynolds, H. C. .....Minneapolis
Rich, L. B. .....Minneapolis
Robinson, F. W., Robinson-Freeman Company....Gould City, Mich.
Russell, George, E. E. Naugle Tie Company.....Chicago
Schussler, M. H., Coolidge-Schussler Company...Floodwood, Minn.
Taylor, J. H.....Ashland, Wis.
Thomas, W. B.....Manistique, Mich.
Valentine, E. H., Valentine-Clark Co.....Chicago
Wagstaff, W. J.....Oshkosh, Wis.
Watkins, W. T., Bradley-Watkins Company.....Minneapolis
Werner, F. W., Bradley-Watkins Company.....Minneapolis
Whitmore, A. E.....Minneapolis
Wilson, George, E. E. Naugle Tie Company.....Chicago
Worcester, C. H., C. H. Worcester Company.....Marinette, Wis.
Wright, J. F., Wright Bros.....Marinette, Wis.

THE SMOKER.

The smoker which was given in the evening by the association to its members and guests was a most enjoyable affair. Through the courtesy of the Commercial Club its banquet hall was placed at the disposal of the cedar men. The music was furnished by Professors Barrett and Nelson. After some feats of magic by Professor Keller, H. S. Gilkey, master of ceremonies, introduced Hon. James C. Haines, mayor of Minneapolis, who said in his address of welcome:

I do not come before you as a necessity but in observance of a time-honored custom. It seems to be the custom in every city that when a body of gentlemen come to that city as guests it is incumbent upon the chief executive to go before them and make a few remarks. I do not know that this is a necessity, but it seems to be the custom and I do not wish to shirk responsibility, so I am here to tell you about your business, which I know absolutely nothing about.

I beg to assure you, however, that it affords me great pleasure to welcome you to our city. I understand that the majority of those gathered here are not citizens of this state, and it may be possible that some of you are making your first visit here among us. We are certainly very glad to have you come and spend a few days with us and all the money you have. I do not know that you will be able to comply with the latter suggestion fully, but I hope you will do the best you can according to the spirit that moves you and the opportunity that presents.

Since you were here last—before you came at all—Minneapolis has become somewhat famous. (Laughter.) It is questionable if we will be able to offer you all of the pleasures and inducements that we might have afforded you once upon a time.

Minneapolis claims to be the metropolis of the Northwest in point of population, business enterprise and outputs. Certainly in its own estimation it is entitled to that claim. We can prove it to you by figures; we can prove it by our own statements—we all know it—therefore it must be true.

My occupation has never been along your lines exactly. If I do not know exactly how to talk to a body of cedar men, I can say to you frankly that I was brought up in the woods; I know what cedar is when I see it, and I have always been thankful that I had my early career in the woods. As I look back at those early days of boyhood's pleasure there is a charm in them even to-day, and I can recall now how I enjoyed breaking loose from civilization to take my chances in the timbered country of the West. It is a pleasure to get close to nature's heart. That is not what you are trying to do, however; you are trying to get next to commerce and the commercial heart. I think you have succeeded pretty well, especially in poles—long poles. They say it is the man with the long pole that gets the persimmon. Anyway, they say that is true in politics, and why then not in business? (Laughter.) You evidently appreciate the point, anyway. While your commercial influence and progressive strength keep your business moving and increasing, you are not purely a commercial body—you are not actuated in all you do and all you undertake by commercial aggrandizement, for you are men of sentiment as well. You are more or less believers in the tie that binds.

Mr. Haines then told of a trip to Cleveland where a good example of the new principle of progression was brought to his attention. A firm in that city had about 1,000 employes, every one of whom was interested to a greater or less extent in the affairs of the company. Once a year the entire force from president to coal shoveler gathered at a banquet where all difference of station was eliminated. On this one occasion the Italian coal heaver was on an equal footing with the president of the company, partaking of the same food, the same wine, cigars, etc. Mr. Haynes stated that this spirit of fraternalism was becoming more and more widely disseminated and was being encouraged by men of affairs; that it was merely a matter of right sentiment, right feeling and the development of that part of human nature which is an attribute of God. Continuing, he said:

Personally, I am conservative, but I have thought a great deal along these lines. I have no panacea to make the country better and to save us from future trouble, but I cannot help but think of the inestimable good that could be accomplished along these lines. It is better to be liberal than parsimonious with the fellow down at the bottom; the fellow at the top can take care of himself. It is better not simply as a matter of commerce and business—there is more money in this kind of treatment of employes and dependents—but it is better because it is right.

I did not come here to read you a lecture, however. I did not have this speech written; in fact, I never wrote one except when I was 15 years old, except my inaugural address. I cannot help having some ideas about this question, for we all have more or less to do with it. But I have said enough along this line.

You are here to transact your business. We hope you will like Minneapolis so well that you will come again and again to be with us in this, the metropolis of the great region that lies around about us, and that our place is good enough for you to transact your business which relates to the welfare of these gentlemen, and I trust that you will feel that you have been well entertained.

I do not know what more I can offer you than this sentiment and the freedom of the city.

At the conclusion of his address the mayor was given an ovation.

Mr. Gilkey then presented Mr. E. H. Valentine of Chicago to respond for the cedarmen. Mr. Valentine began his response with the story of a gentleman and his Swedish coachman. The gentleman resided at Janesville, Wis., and had arranged to spend the winter in Florida. On the way to the station the Swede asked his employer what the distance from Janesville to Jacksonville was, and was informed about one thousand miles. The Swede pondered for a moment or two and then said: "Yanesville to Yacksonville—Yesus, what a yump!" Mr. Valentine applied the story to himself and the mayor, much to the appreciation of the assembled guests.

He then told a story of a friend of his in Chicago—without mentioning the name of the friend—who was stricken with locomotor ataxia. After a couple of years' treatment he was pronounced cured and gave a dinner in honor of the occasion. At this dinner everything went well until near the last when it was evident to the guests that something was wrong with the host. Upon being importuned, he stated that he was afraid there had been a return of the disease, as he had been pinching his leg for several minutes without getting any sensation in response, whereupon a lady sitting next interrupted him by stating that he had evidently got things mixed a trifle, as it was *her* leg that he had been pinching. The application made by Mr. Valentine was that during his stay in Minneapolis he had been so delightfully entertained and had come in contact with so many wide awake and alert business men that he had been kept "very much alive" every moment of his time.

Thanking the mayor and citizens of Minneapolis for the kind welcome extended to the Cedarmen's Association and addressing the mayor, he said: "The ward in Chicago in which I live occupies the unique position of having three candidates for the mayoralty. May Chicago be as fortunate in its choice of a mayor at the coming spring election as Minneapolis has been and may the citizenship of Minne-

apolis, irrespective of party, stand shoulder to shoulder with you in all of your efforts looking to the upbuilding of the fair fame and the continued advancement of Minneapolis' best interests."

The balance of the program was as follows:

Song and dance.....Misses Vedder and Gardner
Solo .....Carl La Pine
Stories .....A. G. Flournoy
Stories ..... W. I. Nolan
Solo .....A. E. Darling

The entire convention was a success and those who attend were amply repaid, the smoker rounding out a day of both profit and pleasure.

INTERSTATE COMPANY INCREASING SERVICE.

By February 1 the Interstate Telephone Company expects to have 1,500 telephones in operation in Trenton, N. J., and to supply its patrons with a long-distance service reaching throughout South Jersey and all points in Pennsylvania. The Trenton exchange is now operating 1,000 telephones, and according to a recent statement made by F. A. Demarest, applications are being received at the rate of twenty a day. Notwithstanding the fight which is being waged by the Bell people against the Independent telephone movement, nearly every business house in Trenton is supporting the new company.

Trenton and Philadelphia are now looked upon as strongholds of the Independent movement in the United States and all the Independent companies in New Jersey and Pennsylvania have entered into traffic arrangements with one another in order to give them a foothold in the territory now controlled by the Bell. The Interstate Telephone Company, although in operation only since September, is now giving a long-distance service as far south as Mt. Holly, including the towns of Bordentown, Burlington, Columbus and other points in Burlington county. Within a few weeks the company expects to have its lines extended as far south as Camden. In Pennsylvania the service has been extended to Bristol, and a force of men is now building a trunk line into Philadelphia, where connections will be made with the Interstate Telephone Company. The local office is now in communication with Philadelphia by the way of Trenton, but the line has not yet been thrown open to the public.

Mr. Demarest said a short time ago that the Interstate Telephone Company was now preparing a traffic arrangement with the consolidated companies of Pennsylvania and the United Telephone and Telegraph Company, which will bring Trenton within speaking distance with the northern and eastern part of Pennsylvania. Within a few weeks, or as soon as the line to Philadelphia is opened, Mr. Demarest expects to have connections made with the Maryland Telephone and Telegraph Company, which will insure communication with all points in Maryland and as far west in Pennsylvania as Pittsburg. As soon as the long-distance service is completed south of Trenton Mr. Demarest will begin to develop North Jersey, insuring connection with New Brunswick, Rahway, Elizabeth, Newark, Paterson, Passaic, Hoboken and Jersey City.

The Lost Chord

By ERNEST McGAFFEY.

Andre Fournier stood in his workshop facing the setting sun. Electrical devices stood in every corner and drawings covered the walls in every direction. On a table in the center of the apartment stood the latest triumph of the inventor, for such Fournier was, in the shape of a vibraphone. This was an instrument which at this time, the year 2003, marked the greatest advance in the science of telephony. Each instrument was made in duplicate and the possessors of one could, by vibration, call at any distance and talk with each other.

The secret of the invention was locked in the brain of the inventor. Like those lost arts, the process of making Greek fire or the satanic poison-potions of the Borgias, it was a matter of individual genius which gave it to the world, and with Fournier would perish at his death.

Each instrument was equipped with a steel, or, rather, a tempered metal bar of steel and some other metals known only to Fournier. The metal bar was fixed rigidly in the case of the instrument, and when struck with a small hammer gave out a clear, bell-like sound. It was not remarkable for loudness, but it had almost an unearthly penetrating quality which lent marvelous carrying quality to the tone. Some sounds in nature have this peculiar power. The call of sand-hill cranes, cloud-high in flight, comes down over rolling prairies with a faint but thrilling intensity of sound.

The duplicate of this vibraphone possessed the same mechanism, the identical apparatus for the production of this sound wave, and the two were enabled to conquer time and absolutely annihilate space. These chord-waves were carried by the ever-shifting currents of the air until the comrade chord-wave was met, and at that instant they were welded as firmly as two blending currents of mist. At that precise moment the slight humming sound of each metal key or telephonic tuning fork would cease and the circuit completed, the owners of the twin vibraphones could converse even from pole to pole with the ease of a tete-a-tete talk in the dimly lighted corner of a conservatory.

As the carrier pigeon, dropped from a balloon mile-high in cloud and darkness, will unerringly turn straight to the course that leads to the home loft, and with swift wings pierce the distance between, so the loosened chord-wave of the vibraphone leaped from the trembling bar and rested not until it reached the goal of its twin vibration.

But to-day Fournier, gifted and almost feared as supernatural by brother scientists, was sad. He passed his slender and nervous hand across his forehead and stood in deep thought. He picked up a violin and swept the bow across the strings, now drawing sonorous, mellow notes from the G string and again rippling off a cascade of high, quivering harmonics from the E string. Music was Fournier's recreation, telephony his passion. He laid the instrument in its case and sat down reflecting. Rising a few moments later, he said to himself aloud, "It is a lost chord; that imbecile assistant."

The explanation of the inventor's soliloquy was as follows, a month before, having completed a vibraphone, and having prepared the metals for the companion instrument at the same time, a careless assistant had fused the metal remaining for the second instrument. A current of electricity, diverted for an instant, had done the damage, and it proved to be irreparable. For something had been lost in the sudden impact of the electric force and the metals being used again did not correspond with the bell-like clearness of the first vibraphone, nor was the sound identical.

Fournier had made several attempts to catch the exact

double of the original instrument's chord-wave, but the result was always disappointment. And so on this autumn evening, with the sun blazing down in dying glory in the west, he sat and brooded.

"A lost chord," he repeated, and stepping to a second table he took a heavy cloth from the companionless vibraphone. It was the gesture of one who takes a handkerchief from the face of the dead. A knock at the door recalled him to himself and he strode to the entry and opened the door.

A tall and saturnine looking man entered, giving Fournier a quick grasp of the hand as he stepped into the room. "Henri!" exclaimed the inventer, "I am glad you are here; are you ready for our trip?"

"Quite," was the response; "we will leave in the morning at four."

Henri Pierrot was of a different caliber from his friend. A man of immense muscular strength and capable of great endurance, a trained athlete and fond of outdoor sports and wild life, he seemed the last man to be the close comrade of Fournier. But the rather slender and intensely thoughtful inventor found a more than brotherly affinity in his robust comrade and the two were as Damon and Pythias in their affection for one another.

Pierrot was a mountain climber among other things and was never tired of looking from the tops of beetling precipices and almost inaccessible peaks out over the world below, spread like a panorama at his feet. His enthusiasm had been communicated in part to his friend and the two had taken several trips to the less difficult mountain passes together. The present ascent was one which they had planned for weeks and which was attended with no danger. It took them to one of the upper Alps, which was comparatively easy of approach and where the magnificence of the view was world famous.

A hut on the top of the mountain, built by the guides, rested close to the summit and they had planned to pass the night there. The following day found them on their journey. Outside of the ordinary outfit of the Alpine climber Pierrot carried nothing. Fournier, however, by a strange freak for which he himself could give no reason, brought with him the vibraphone which had been puzzling and baffling him with its elusive and not to be duplicated chord-waves. It was light and nothing in the way of a hindrance. As for that, the guides could carry it. But why bring it at all? Fournier smiled and shook his head. Pierrot shrugged his shoulders and said nothing. He was used to the vagaries of genius.

At the hotel the two friends stopped and retired early, having completed preparations with two hardy and experienced guides for the ascent on the next morning. By dawn they were astir and a couple of hours later they might have been seen by the aid of a good telescope creeping over the brow of a hugh hump of the mountain like flies crawling slowly up a ceiling on a frosty morning.

That night they arrived at the hut and ate a hearty supper, prepared by their guides. The two friends at the conclusion of the meal sat and smoked until the stars were out, watching in silence the pale gray rings of smoke that lost themselves above their heads. The moon, radiant in her robes of shimmering light, cast her rays from peak to peak, glinting the towering pinnacles as with a frost work of purest silver, bathing the crags in the blue-green haze of an Alpine night.

Fournier stepped lightly into the hut and brought out a bundle and his friend smiled as he recognized the covering which had enveloped the vibraphone on their upward trip. Opening the wraps, Fournier disclosed the instrument. Then he turned to Pierrot and said in a mocking tone, "Perhaps the twin chord of this instrument is abroad tonight. Let me give the signal in this impenetrable quiet and await results."

He struck the bar with the metal hammer and the chord leaped out as a bird from a cage and soared into the night. Sweet it rose, as a lark carries above its rippling concord of sweet sounds, and sank at last into silence.

"It is part of the night and the clouds," remarked Pierrot to his friend. They smoked their pipes in absolute quiet for a few minutes, when Fournier, turning again to the instrument, was amazed to find that the sensitive metal bar had become perfectly rigid.

Pierrot noticed his friend's agitation and laughingly said, "A message from the stars, eh, Fournier?" The latter caught up the instrument and adjusted the receiver to his ear. Faint and fine he heard a muffled murmuring, which gradually resolved itself into the tones of a voice. He listened with nerves wrought up to a throbbing pitch of fiery intensity. His wonder broadened as he began to distinguish the language which the mysterious communicant was using.

It was Latin, and to Fournier, educated in the best French academies, Latin was almost as familiar as his mother tongue.

"What star is this?" was the first query which came singing almost inaudibly through the distance.

"The earth," was Fournier's reply.

"Ah, yes," was the response, "one of the least of the lesser satellites."

"What star are you speaking from?" was Fournier's question as the echo of this remark died away.

"The inhabitants of your little world know it as Mars," was the answer.

"We have always believed it as inhabited," was the inventor's reply.

Pierrot sat by stricken dumb by what he believed a temporary aberration of his friend's mind. Meanwhile the conversation went rapidly on.

"How did you obtain communication with the earth?" said Fournier.

"We have instruments which cast sound as the sun's rays are cast downward," was the response; "when a correspondingly exact sound is met by one of these sound-currents of ours, communication is established between us and any other world or star."

"The very principle of what we call the vibraphone here on earth!" cried Fournier.

"What do you do in Mars?" said the inventor. "Have you cities, armies, agriculture, poets, inventors, musicians, the arts and sciences, marriage, death and religion?"

"All those and much more," responded the voice. "We have cities of many billion people. We have ships that sail the waters of unsounded seas; armies whose clash in battle is the thunder which you hear in stormy skies, their dusky banners the clouds which obscure your skies when the fight is fiercest. Everything which you on earth possess, we in Mars have in greater glory a thousandfold."

"How do you come to know so much about our world?" asked Fournier.

"Our men of science," was the reply, "have solved most of the secrets of the rest of the universe," was the answer. "We know of your star and little is hidden from us concerning its inhabitants."

Pierrot could not drag his comrade away from his fascinating and weird conversation. Far into the night the inventor talked with the mysterious stranger. He learned that his strange communicant was a woman; that the dwellers in Mars worshiped Jove and builded temples to that deity, and to Hercules, Apollo, Venus, Ceres and Mercury; that they were great in the arts of war and peace; that their league-wide rivers flowed from mighty mountains and the sails of their commerce dotted the waves of measureless seas.

In turn he told of the wonders of this world and sounded as best he could the glories of modern civilization. He

found that much that was common in the far-away star with which he was holding communication was the same as here on earth.

All the high-strung emotions of the inventor leaped and quivered under the impetus of this miraculous adventure. That night he tossed uneasily on his rough couch and in the morning he could talk little except about the experiences of the night previous.

He had learned from his strange acquaintance that only in autumn, when the air was particularly clear and light, and on such a cloudless night as the night when the chord-waves had met, was it possible to establish communication by means of the different instruments through which they had succeeded in bridging the vast void lying between Mars and the earth.

Pierrot shrugged his shoulders and looked alarmed and serious over his friend's enthusiasm. He tried in every way to curb the gush of excited words which bubbled over at Fournier's lips at the very thought of this most miraculous triumph of science.

They remained on the mountain top for three days, but the conditions were never as favorable as on that enchanted night and Fournier was unable to converse with the Martian again on that trip.

A week later found the friends once more on the brow of the mountain, and again the air was clear and bright and again the moon rolled in solemn beauty through a cloudless sky.

And again the inventor smote the trembling metal bar and evoked a response from Mars, far-burning in the vague and mighty vistas of eternal nature. And once more the sibilant and unearthly whispers of a spirit conversation were wafted down until the gray dawn came silver-stoled along the mountain tops and blotted out the stars.

Fournier lost color and became moody. Pierrot consulted the leading physicians. Rumors of the inventor's almost genii-like powers went chattering among the cities of the world, babbled in the boudoirs of elegant ladies, gruffly scoffed at in laboratories and on street corners. The inventor was importuned to write of his wonderful discovery, but no temptation could make him divulge the secrets of his messages across the void. To Pierrot he confided little beyond the fact that his unseen friend's name was Iriel and that she was as a spirit and a woman, both in one.

Pierrot, grieved and offended by the change in his old comrade, soon quitted his companionship and sought new company.

Fournier the next autumn toiled up the mountain side, the guides accompanying him. A storm had broken over the travelers. From black clouds the lightning flickered like the tongue of an angry snake. Thunder rolled in hollow defiance among the chasmed hills. Suddenly a red bolt flashed earthward like a descending rocket and struck at the foot of a gnarled tree, where the rearmost guide was resting with the vibraphone on his shoulder.

It was over in an instant. The guide, burned and blackened by the electric messenger, lay a corpse. By him the vibraphone lay twisted and shattered, the metal bar fused into a shapeless mass.

Fournier was in despair. He remodeled the vibraphone, but, as in the case of the careless assistant, the current of electricity had ruined the delicate timbre of that bell-like and not to be duplicated tone. He built other vibraphones and haunted the mountain side in a vain endeavor to again catch the invisible note which had bound him to Iriel. But a fresh disappointment met his every effort and for three years he strove but to find his work a mockery.

He failed in health. His wonted color left his cheeks. He muttered to himself and his friends fell away from him as from a man afflicted. He spoke of Pierrot in his speech, but oftener of Iriel. His violin lay untouched in its case until the strings snapped one by one and the bow and the instrument itself gathered a fine white shroud of dust. His books were unread, his room in disorder and only the faithful old servant of his happier days was left to heed his sorrow.

* * * * * *

"Did you talk with the Frenchman?" said Dr. Livingston to me as I descended the steps of the asylum.

"He told me all about the communication with Mars," was my reply.

"And Iriel?" was Livingston's next question.

"And Iriel," I replied.

"He had a great future as a telephonist," said Livingston, musingly, "but his wife died and it was too much for the poor fellow."

"And his wife's name?" I added.

"Her name was Iriel," said the doctor.

BELL SERVICE IN PITTSBURG.

The man who invented the telephone was a genius. The men who improved it were geniuses. Their genius was of the constructive and helpful order. The world pays due homage to the men who discover great principles and who put those principles to practical application, says the Pittsburg Times. But along with the helpful geniuses of the telephone there is another, a marvel in his paretic way, who is peerless among men. He is the living evidence that "great wits to madness closely are allied." He is the fellow who invented the insane drivel that is the system now in use in telephone offices for answering calls. A man goes into his telephone box and in a suave tone asks for 4-11-44 Soho. About the time he has said 4-11 a voice is fired at him like a bucket of bricks, saying: "Number, number, number," with an insinuating and offensive inflection on the last syllable. The man tries again to butt in, and about the time he has marked down his 4-11 he gets another jolt with that number business three times bumped in his ear. He stabs away at his 4-11 and presently the interrupting voice breaks off and he listens for an answer from his Soho correspondent.

Presently that stereotype-room voice cuts in again. This time it is: "Waiting, waiting, waiting." The man answers that he is waiting and wants 4-11, but about that time the wire gives a whiz and he hears all manner of conglomerated sounds. Then his neighbors begin to talk of the price of steel, the stage of water, where Nellie bought her ruching, just how soon that turkey will be up, and such other interesting gossip, and again all quiets down. Just as he is about to ring again the voice from the stereotype department hammers off a few more pieces of "waiting, waiting, wait——" and then he tries to catch the ear of the speaker long enough to assure her that he is waiting and to ask what in the name of the seven gods she thinks he has been doing for the last ten minutes.

* * *

The pleasantry is lost. The stereotype-room voice has broken off and the man stands there with the incompetent fixture digging in his ear. Presently he rings again. A gentle voice comes over the wire: "Number, number, number," tit-tat-toe, three in a row, always the same incendiary drivel, "number, number, number," or "waiting, waiting, waiting," until the man recalls the day he put in paying a social visit with the superintendent to the various wards of the West Virginia Insane Asylum. The man waits. He cannot divert himself by doing a jig. You can never sidestep the hand-me-down wail of sorrow from the central office, for if you turn away from the machine you are lost. If you stay, at intervals that voice, like the dolorous croak of the raven, comes over the wire, "waiting, waiting, waiting," until the man thinks that murder or a fire or small pox would be a pleasant diversion. Meantime his temper is get-

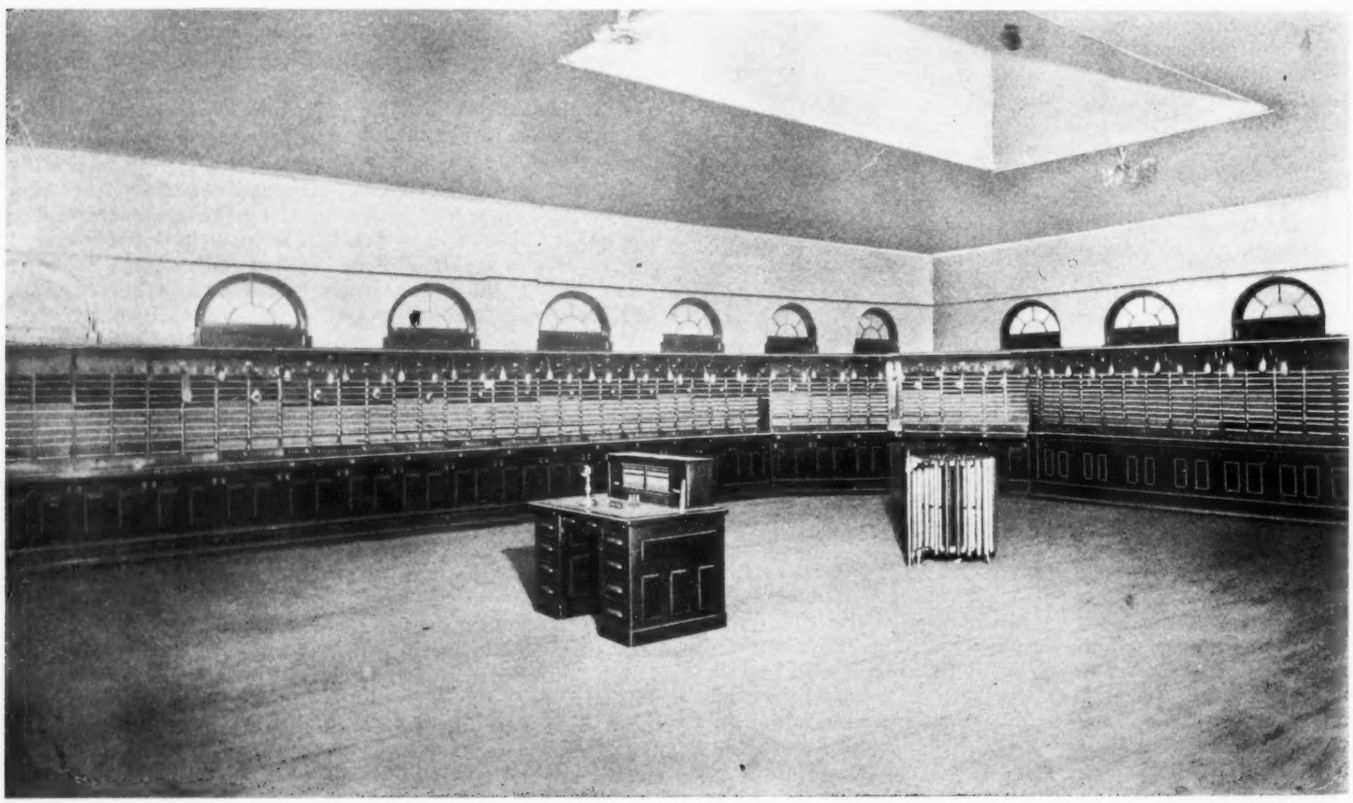
ting roiled. He asks, when he can break in, if they are all dead or if the funeral will soon be over. He calls in desperation for the number of the head waiter of the outfit, but before he can get it to file his complaint that everlasting store-clothes voice gets into commission again and he hears "number, number, number," in its aggravating tone. He tries to say that he wants that same old 4-11-44, but before he has said half of what he wants to say he hears the wires get busy again with somebody else. Then he stands there like a cheap piece of mud statuary and waits for the next symptom of mental feebleness, and it comes, "waiting, waiting, waiting." It is like the hours of the clock, drawn out about as long and accomplishing about as little as the clock does, which is nothing but to mark the flight of time.

* * *

The men who invented the telephone were geniuses. The fellow who devised the paretic system of carrying on a great business with two imbecile words, uttered in imbecile fashion at irregular intervals, to nullify the powers of the telephone, was a genius, too. A few words of intelligent English never hurt the tongue of anybody and would not interfere with competent service in the telephone office if more than two words were allowed, but the bright mind that concluded that two words were enough seems to have been in authority. Probably it is enough to correspond with the rest of the service, for if there is anything else in the world classed among the public utilities or the conveniences of civilization that proves so often so aggravating and thoroughly incompetent as the telephone it is not now recalled. It is not particularly the fault of the telephone. It would work right if it had half a chance. It has been known to do excellent execution at long range, and under proper conditions if freed from its connection with the insane ward it might be a help rather than a source of irritation. But it is a public calamity that when a man is in a hurry he allows himself to be deceived into wrestling with a telephone for half an hour instead of taking fifteen minutes to run around the block and present his communication in person. Of course the telephone sometimes allows of the use of more than two words, which is the only thing that keeps it in its position to nag the human race all the rest of the time.

Interstate Telephone Company of Trenton, New Jersey.

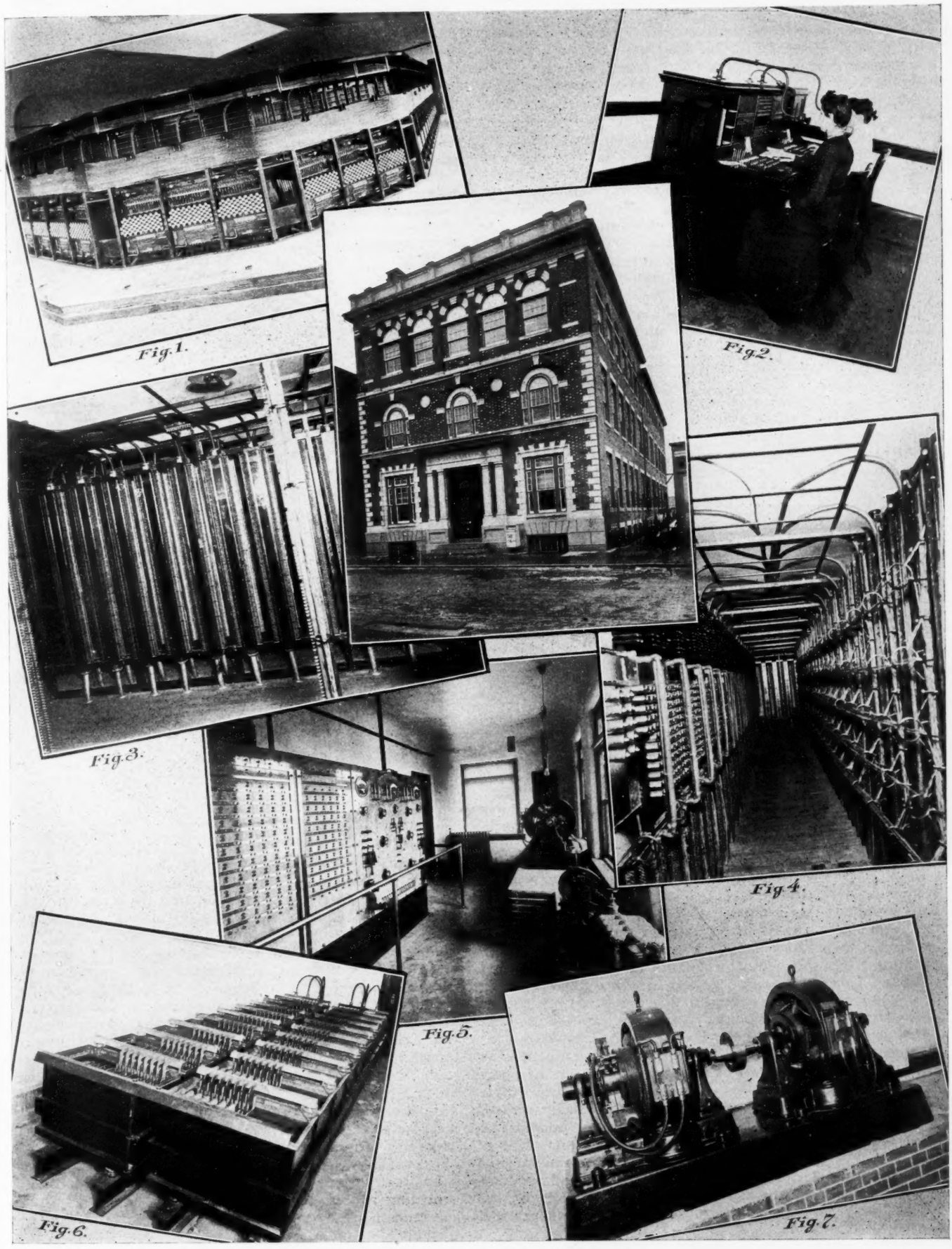
In this issue of TELEPHONY is shown illustrations of the general office building and operating department of the Interstate Telephone Company of Trenton, N. J.



MAIN SWITCHBOARD TRENTON (N. J.) TELEPHONE COMPANY.

The success of any important undertaking largely depends upon wise and careful management, and the telephone business is not an exception to this rule. The Inter-State Telephone Co. has secured the most expert talent in the scientific departments. Hon. C. W. Kline, its president, is a gentleman who was a pioneer in the Independent telephone movement in Pennsylvania, where he has ever since been actively and prominently engaged in organizing and conducting Independent telephone companies, and otherwise.

The general manager of the company, Mr. F. A. Demarest,



EXTERIOR AND INTERIOR VIEWS OF THE INTERSTATE TELEPHONE COMPANY.

is also an expert electrical engineer of long experience, having been identified with some of the most successful Independent telephone companies of the East, and combines with an almost inexhaustible electrical knowledge an extraordinary executive ability, which combination of attainments is so rarely to be found.

Although the Inter-State Company has only been in existence a little over eighteen months, it has already a large number of telephone systems in operation throughout the State of New Jersey. The company is giving service in fifty cities, towns and villages, and is engaged in rebuilding these exchanges and connecting lines in the most approved method.

The plant of the telephone company at Trenton is the first to be completed by this company. It comprises nearly nine hundred and eighty-five miles of wire in aerial cable, and over five thousand eight hundred and forty miles of wire in underground cable.

The underground conduit system of the company consists of 65,982 feet of trench and aggregates over 261,648 duct feet. The cable, both aerial and underground, was installed by the Standard Underground Cable Co., and consists of No. 19 B. & S. gauge double wrapped wire made up from specifications of this company.

In the aerial construction, the company uses circle top distributing poles, averaging from 65 to 70 feet in height.

The policy of the telephone company is to do away with as much open wire as possible. Aerial cable runs nearly to the city limits, and cable boxes are placed at such intervals that a subscriber's drop will only, in extreme cases, have to extend over four poles in the outlying districts.

The cable is potheaded at the distributing poles and fused in the cable boxes; the fuses being of the American Electric Telephone Company's tubular design.

The bridle wire is No. 18 rubber covered and braided and runs through glass enameled rings to the insulators on the distributing top.

The drop wire is of single No. 19 rubber covered and braided.

In the construction of the Trenton exchange no bare wire was used.

In the undeground construction ample space has been allowed in all manholes for carrying cables. There are over two hundred and ninety manholes in the underground system of the Trenton exchange. Ample duct capacity has been provided for increasing the capacity of the exchange.

Every subscriber's station is wired in the best possible manner and nearly all wiring is concealed. The subscriber's instrument is protected by a D. & W. fuse block. The system of protection used by this company is of the best, consisting of carbons and heat coils at the exchange, fuses at the terminal poles and fuses, carbons and heat coils at the subscriber's instruments.

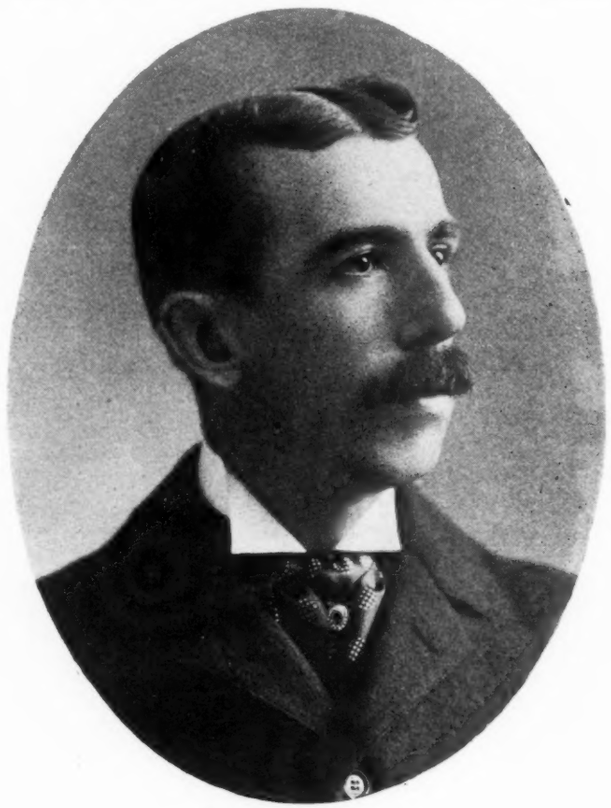
The offices of the company are in the company's own handsome three-story building, located at No. 18 South Stockton street. The basement is used as a storeroom and shop. The first floor is occupied by the local offices and inspector's rooms. The second floor is given up to the general offices of the company, and the apparatus and switchboard of the Trenton Exchange is located on the third floor. Operators' retiring lockers and dining rooms are provided for the comfort and convenience of the operators.

The territory covered by the company is thickly settled, and embraces a population of over 500,000 inhabitants. Some of the most important cities being Trenton, Patterson, Atlantic City, Mt. Holly, Bordentown, Elizabeth and Millville, with numerous smaller adjacent towns, all of which when connected by the toll line system, now planned, will constitute a net work of profitable and useful Independent telephone lines, unexcelled in any Independent territory.

The telephones and central office equipment, including all of the terminal facilities and power plant, were manufactured by the American Electric Telephone Company of Chicago, who make a complete line of modern telephone equipment.

The executive force of the Inter-State Telephone Company is as follows: Hon. C. W. Kline, president; A. M. Worstall, secretary; Barker Gummere, Jr., treasurer; F. A. Demarest, general manager.

The Trenton main exchange switchboard, as shown in illustration, has an immediate capacity of 2,640 lines and is arranged in all portions for permitting an ultimate increase to 5,000 lines. In this particular equipment each operator's position is provided with 120 subscribers' lines; the subscribers' signals consisting of miniature lamps placed immediately above the answering jacks. Each operator's



F. A. DEMAREST.

position is provided with 15 pairs of interconnecting equipments, consisting of double supervisory signals, ringing and listening keys, selective signaling keys and the usual complement of operators' cords, plugs, transmitter, receiver, etc.

In the foreground will be observed a chief operator's desk, which is arranged for operating in conjunction with the main switchboard.

Figure 1 shows a rear view of the switchboard at the point where the turn in the cabinet occurs, giving an excellent idea as to the general disposition of the apparatus contained in the switchboard. In the center portion of the switchboard it will be observed that the multiple jack cables are laid, while immediately above them we have the answering jack cables, and immediately below the multiple jacks the connecting rack as well as the supervisory relays and operators' terminal rack.

It is, of course, understood that the rear of the switchboard is ordinarily closed up with lift panels or doors, thus providing against the entrance of dust, dirt or any other substance liable to interfere with the proper maintenance of the apparatus in the switchboard.

In figure 2 we have a view of the toll line switchboard

which is operated in conjunction with the main switchboard. It will be observed that this switchboard provides for two operators' positions, extending the capacity to any desired number of lines.

A peculiarity of this toll line switchboard consists in the feature of providing what the Inter-State Company technically term a "local long distance multiple." This multiple, it will be observed, is located between the two operators and is provided for the purpose of permitting the connection of city subscribers directly to the toll line switchboard multiple. That is to say, after determining that certain city subscribers have occasion to use the toll lines, a multiple of their circuit is run to the toll board, and thus permits of the toll operator obtaining quick connection with such subscribers without having recourse to the numerous trunks provided.

In figre 3 we have a view of the terminal heads, which constitute a combined terminal sneak-current and lightning arrester of the well-known Burns' type. It will be observed that these terminal heads are backed against each other, permitting of their taking up the smallest possible amount of space.

In figure 4 we have an excellent view of the terminal cross-connecting and relay rack. This shows one-half of the rack installed in the Trenton equipment. On the right, we have the cross-connecting board, clearly showing the perfectly clean disposition of the jumper wires and the ease of access to this particular portion of the exchange equipment. On the left, we have the impedence coils in the upper portion of the photograph, while immediately below are the line signal relays, and below this, the intermediate cross-connecting boards, while in the distance to the rear we have a partial view of the terminal heads described in connection with figure 3.

The floor, it will be observed, is arranged with trap doors to permit access to all cables lying beneath, while in the upper portion we have the cable racks carrying all cables connecting to the various parts of the equipment.

In figure 5 we have a view of the power room. On the immediate left we have the two fuse boards connected together with the power board. This power board is what the American Company call their "No. 3 type," which means that it is an equipment in which are provided provisions for duplicating charging and ringing equipments, together with a low reading voltmeter permitting of feeding each cell of storage batteries separately.

The power and fuse boards consist of the finest grade of Tennessee pink marble, and were especially selected for the Trenton installation.

To the immediate right we have the combined ringing machine equipment, consisting of a combined low and high frequency selective installation. In explanation of the above term, it should be stated that the equipment consists of two ½ h. p. frames; one of these frames is provided with a 220 volt winding, and an auxiliary winding, for giving the regular 20 cycle alternating current on regular subscribers' telephones. Direct coupled to this machine, we have a 6 pole, ½ h. p. frame equipment so built and wound as to deliver a 60 cycle alternating current at the proper potential and capacity. A peculiar feature of the machine consists in its being wound for self-excitation, this permitting of making this winding suitable for being driven by the 40 volt storage battery, which forms a part of the installation, and which is shown below.

The entire equipment, as it stands, provides, therefore, for giving a 60 and 20 cycle current and is suitable for operating the regular American Electric Telephone Company's party-line system.

In the rear of the power room we have the charging machines, more plainly shown by figure 7. These machines being of the regular noiseless telephone generator type, 10 h. p. frame and driven by a 220 volt direct current.

In addition to this equipment the Inter-State Company have installed an alternating current charging equipment in the basement of their exchange building; this being of the same capacity and general construction as the one shown in the illustration and used as an emergency set for charging storage batteries.

In figure 6 we have a view of 20 storage batteries used in connection with the Trenton installation. It will be observed that these storage batteries permit of an ultimate extension to more than double its present capacity. It will further be observed that the battery tanks are mounted on steel eye beams directly set upon the floor; the floor being of cement, as is the usual practice in the most approved exchange construction.

THE TRUE NET EARNING POWER OF TELEPHONE PLANTS.

If the owner of telephone securities is interested in street railway enterprises he can learn that with well-managed companies it is an invariable rule in determining the true net earning power of street railway properties to estimate what depreciation is likely to be from the day the plant is placed in operation, and to make the sum agreed upon a direct charge upon revenue through operating expenses. If he is financially interested in the local lighting plant, he knows that it is an established rule in all prosperous companies to set aside a certain sum each year to cover repairs, renewals and such minor extensions and betterments as will keep the plant intact and the investment unimpaired. If he is a manufacturer he knows that wear and tear follow every turn of the wheels; that by reason of radical improvements the value of the machinery often depreciates much more rapidly in cost value during the first five years than later in its existence; that competition is spurring inventive talent now as never before and bringing out improvements that are revolutionizing methods and machinery; that all expenditures for replacements and renewals that do not increase the capacity of the plant are properly chargeable to expense; and that in many mills and many factories a severe loss is sometimes sustained by reason of the heavy shrinkage in the values of raw material laid in when high prices ruled, and, hence, depreciation is figured not only on the raw material remaining but on the manufactured stock made up before falling prices set in. If he is a merchant, he is familiar with that phase of depreciation that lessens the value of old stock as new styles and new patterns appear, or decay sets in, or frost and dampness ruins—a direct loss and usually chargeable to profit and loss. If he is a shareholder in a steam railroad, he is familiar with the large number of locomotives, coaches, and other rolling stock that have outlived their day of usefulness; of rails and ties too light for the heavy traffic of to-day; of roadbeds still serviceable, yet abandoned for others affording lighter grades, longer tangents, and fewer curves. If he is a manager of a steel mill, he can tell how often modern mills have been compelled to discard costly machinery that has depreciated in value, not through wear and tear, nor by reason of accident, but either through a modification of the type of product, or because equipment of far higher efficiency and more automatic in action has been adopted by competing companies, thus enabling the latter to place their product on the market at a lesser cost. And, if he is the manager of the mill, he will readily understand that the first cost of this new machinery is not the only factor entering into this phase of depreciation. For there must also be included the reduced output in product, the temporarily reduced efficiency of the operatives, and the losses due to error in the first operating of the machinery, largely traceable to that absence of enthusiastic co-operation that marked the movements of men and machines under the method which was discarded by reason of competitive pressure.

THE MAKING OF A TELEPHONE MAN.

BY F. W. BRIGHAM.

The men who will step into the higher executive positions of the telephone service will have a very different training from that of the veterans preceding them. Today comparatively few of the superintendents and general managers of telephone exchanges bring to their work that technical training which is essential to the solution of the difficult problems which are constantly arising. Their training has been practical and not theoretical, and their knowledge of the scientific principles governing the construction, maintenance and operation of exchanges has been gained by hard knocks. They know certain things must be done in a given manner to secure a certain result; but only a small proportion of them are able to go down to the scientific principles and give a clear analysis of the whys and wherefores of the question. It is in this respect that we may expect to see decided changes in the processes which go into the making of a telephone man.

The time will never come when a man will be able to stand in a high position in the operating branch of the telephone service and discharge the duties of such a position in a manner to deserve the praise signified in the phrase "a good telephone man" without having a clear, practical and first-hand knowledge of the details of the telephone work from its fundamentals to its most complicated processes. He must be practical at every step, and that implies that he must work up from the bottom and himself take the steps in which he is to direct others. From the viewpoint of the manager and superintendent nothing can take the place of experience. The general manager who does not know the actual process of so seemingly small a matter as setting a pole, is likely sooner or later to make himself ridiculous in the eyes of the boss of the construction gang.

On the other hand there is nothing so practical as real science, which goes direct to principles and causes. The tendency now is more and more towards the mastering of fundamental principles, to learn why and how certain causes produce certain results. It is no longer sufficient for the executive man engaged in telephone work, more than in any other line of human effort, to know that doing something in a given manner will give a desired effect. He must be master of the principles of the operation or he is liable to make serious mistakes and is handicapped at every turn.

Therefore, in my opinion, the men who are to be the future executives of the world's important exchanges will stand on the foundation of a thorough theoretical as well as a practical training. And they will be more practical for that kind of a schooling, provided they do not attempt to jump over the hard, practical details of what may seem to them the humble and possibly unimportant parts of the business.

It is to be taken for granted that no man will be advanced to a responsible and important position without displaying in a reasonable measure that capacity for practical affairs generally called executive ability; but there are special quantities which seem very essential for the service. The man who does not possess them has not in him the making of a good telephone man.

The first of these endowments is a natural and inherent tendency to do full justice to the humblest as well as most influential person with whom, as an official, he is brought into contact. He should have the courage to dig to the bottom of every problem, complaint or contention, and having determined in his own mind the right and wrong of the matter, nothing should deter him from making a decision on the lines of exact justice. In no other way can a manager or superintendent of an exchange build up a proper spirit among the men under him. If he cannot inspire in the public the knowledge that they will be treated fairly and squarely in every matter that comes to his attention he should set himself down as a failure.

Decision is another imperative quality for the higher positions of the telephone service. The spirit of the telephone service is expressed in one word: rush. Broadly speaking, its affairs must move swiftly and admit of no delay. It is seldom that a manager or superintendent has time to deliberate over a question, and if he lacks the capacity to arrive habitually at prompt decisions he is out of touch with the spirit of his surroundings, and liable to fatal error by reason of his weakness. If his heart is not wholly in his work, and if he is not gifted with that rare talent for practical affairs termed executive ability, he will find the work killing.

The official who takes his work home with him and carries his problem to his chamber cannot last long. The strain is bound to be too intense and the chance for recuperation too small to keep the pace going. One of the vital and imperative rules of a telephone official's life should be to leave his work at his office.

PERSONAL

Ira Wells has taken charge of the telephone exchange at Russell, Iowa.

I. J. Kusel, president of the Eureka Electric Co., has just returned from an eastern business trip.

C. E. Stinson has resigned the general managership of the Rochester, N. Y., Telephone Company.

Cyrus O. Baker, representing Baker & Co., 120 Liberty street, New York, visited Chicago recently.

James H. Parish of the Standard Telephone & Electric Company of Madison was a recent Chicago visitor.

Harmon A. Harris of the Automatic Electric Company is in the east on business in the interests of his company.

Harry Graham has resigned as manager of the Norwalk, Ohio, exchange. His successor has not yet been appointed.

D. C. Hemingray, secretary of the Hemingray Glass Company, of Covington, Ky., was a recent Chicago visitor.

Miss Lillian E. Foley has been appointed chief operator for the Southwestern Telephone Company at Denison, Texas.

Fred B. Patten, president of the Illinois Electric Specialty Company, has just returned from a business trip through the west.

H. E. Procunier, president of the Moon Mfg. Co., Chicago, is making an extended European trip in the interests of his company.

Lew Pettit has been appointed manager of the Colfax Telephone Company at Colfax, Iowa, assuming charge the first of the year.

Charles E. Brown of the Central Electric Company and W. W. Low of the Electric Appliance Company were recent visitors to New York.

John A. Russell, well known traveling salesman in the telephone field, has accepted a position with the Swedish-American Telephone Company.

Ed Barkalow, of the Kokomo Telephone & Electrical Mfg. Company, recently superintended the installation of the switchboard at New London.

Vinton A. Sears, vice-president of the Eastern Automatic Telephone Company of Boston, recently visited Chicago in company with eastern capitalists to visit the Automatic Electric Company's factory and the much talked about Chicago

tunnel. Mr. Sears feels very sanguine as to the success of automatic telephony.

Charles C. Kritzer, formerly manager of the Zenith Telephone Company at Duluth, has taken a position with the Highland Canal & Power Company.

E. R. Harding, western manager of the Holtzer-Cabot Electric Company, has recently returned to Chicago after an extended business trip in the east.

F. E. Bell, of Mt. Horeb, Wisconsin, and formerly of Baraboo, where he was engaged in telephone manufacturing, recently visited Chicago factories.

Frank G. Jones, president of the American Electric Fuse Company, is the proud father of his first boy and gracefully accepts the congratulations of his friends.

Walter E. Doolittle, president of the Sterling Electric Company, recently passed through Chicago from a western business trip and reports a number of new contracts.

John H. Reid, Philadelphia manager for the American Electric Telephone Company, in an interview in New York prophesies a busy season for the manufacturing companies.

C. D. Cook of Chicago has been appointed manager of the Harrison Telephone Company in the Black Hills, vice George Cornwall, resigned, who enters the service of an eastern company.

D. T. Foley, formerly with the Western Telephone Construction Company, has been appointed general superintendent and purchasing agent of the Vought-Berger Company of LaCrosse, Wis.

George W. Westney of Belding Brothers & Co., prominently identified with the silk trade, has just returned from an extended eastern trip and reports a large demand of goods in his line among the manufacturers of insulated wires and cords.

George A. Briggs, president of the Chicago Telephone Supply Company, Elkhart, Indiana, was a recent Chicago visitor. Mr. Briggs reports an ever increasing demand for Chicago apparatus, which necessitates the running of the factory day and night.

M. I. Berger, secretary and treasurer of the Vought-Berger Company, La Crosse, Wis., who was a recent Chicago visitor, reports, among other contracts closed by the company, one for one thousand central energy telephones for the La Crosse Telephone Company.

J. B. Ware, formerly of Grand Rapids, who resigned the management of the Citizens' Telephone Company to accept a similar position with the Independent Company of Detroit, has resigned the latter position and accepted a responsible position with the Independent Long Distance Company of New York, with headquarters in Buffalo.

Guy Owens, president of the Guy Owens Electrical Construction Company, Ltd., of Honolulu, Hawaii, is making a business trip through the States. Mr. Owens has been in the islands six years, and has constructed a number of city and plantation telephone exchanges, beside a great deal of other electrical construction work. While in the United States Mr. Owens will make his headquarters at 6241 Kimbark avenue, Chicago.

OLD TELEPHONES ON EXHIBITION.

G. A. Selser of Doylestown, Pa., has deposited in the Bucks County Historical Society Museum the first pair of telephones ever used in Bucks county. On May 16, 1878, Mr. Selser and Thomas Frazer talked from Doylestown to Quakertown over the Western Union telegraph lines, virtually stealing the line for that Sunday afternoon by cutting out connections south of Doylestown and north of Quakertown. In those days the receiver was used as a transmitter also.

WELL KNOWN HEADS OF WELL KNOWN HOUSES.

James H. Parish, whose portrait appears in this issue, entered the Independent telephone field in 1893. He, with others, including Count Mitzkowitz, secured valuable concessions from the Chinese government granting the right to building and operate electric light and telephone plants in several of the large cities of China. The project, however, was not carried out for the reason that at that period of financial depression in the United States, sufficient capital could not be secured for the enterprise. Mr. Parish afterwards became connected for a short time with the Harrison International Telephone Company of Chicago. With others he assisted in the organization of the Detroit Telephone Company, Detroit, Michigan, remaining there until the exchange was completed, which at that time, was the largest Independent telephone plant installed, having over five thousand subscribers. From Detroit Mr. Parish went to St.

JAMES H. PARISH.

Louis and assisted in the organization of the Kinlock Telephone Company, now one of the largest Independent telephone companies, with about ten thousand subscribers. After the work of the organization of the Kinlock company had been completed he returned to Chicago and became connected with the Kellogg Switchboard and Supply Company, when that company was organized, and remained in its employ until he assumed the position of manager of the Sterling Electric Company's Chicago office. Upon the reorganization of the Western Telephone Construction Company he was associated for a short time with that company until he accepted the position of secretary and general manager of the Standard Telephone and Electric Company of Madison, Wisconsin. Mr. Paris is a man of strong character and staunch integrity and has made many friends by his affability and courteousness. He brings to his present position the many attributes that count for lasting success and stability.

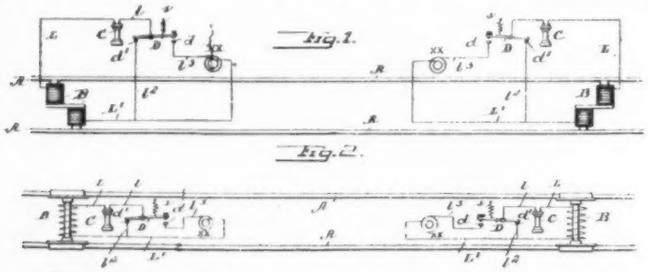
DIGEST OF TELEPHONES AND KINDRED PATENTS

Conducted by EDWARD E. CLEMENT.

DECEMBER 16, 1902.

715,817—I. Kitsee, Communication with the Aid of Electromagnetic Devices.

This invention comprises a system for transmitting signals by means of magnetic impulses, instead of the electrical impulses to which we are now well accustomed. The invention is shown applied to a railroad, the steel rails being employed as the means of transmitting the magnetic impulses or waves. In Fig. 1, A-A are the steel rails of an



715,817—COMMUNICATION WITH THE AID OF ELECTRO MAGNETIC DEVICES.

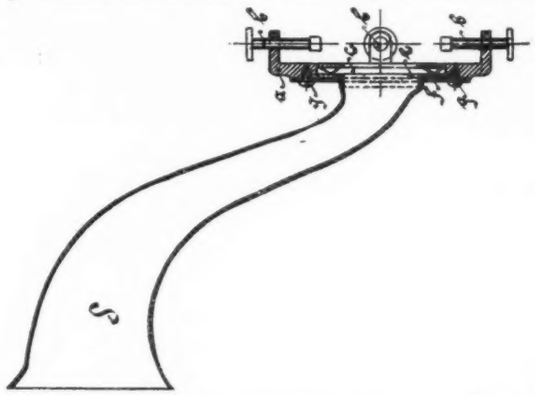
ordinary railroad track, B is an electromagnet having its opposite poles connected to the opposite rails, XX is a generator of alternating current, and D is a transmitting key. From the electromagnet B a wire L passes to the key through a telephone receiver C, and thence by a normally closed branch l2 back to the magnet. In a normally open branch l3, from the key to the magnet, the generator is connected. The same arrangement is followed at all the stations, and the operation is as follows: normally the generator is cut out and the receiver C is in a closed circuit with the magnet B; but when a signal is to be transmitted the key D is depressed in accordance with the Morse or other code, and a number of waves of current are therefore permitted to traverse the windings of the electromagnet, greater or less according to the duration of the depression. The polarities of magnet B are rapidly reversed in response to the current changes, and these polarities are communicated to the rails A-A, and by them conveyed in successive magnetic waves along their length to the electromagnet at the receiving station, which has its magnetism reversed in accordance therewith, a current being thereby generated in its winding, and affecting the telephone receiver C. This arrangement can be followed in a fixed station. For a movable station, as on board a moving car, the wheels and the axle are employed as shown in Fig. 2, to take the place of the magnet B, the circuits and other arrangements remaining the same.

715,878—A. Schoeler, Swiveling Trumpet for Telephones.

This is really an adjustible mouthpiece for transmitters. It consists essentially of a supporting disk a carrying setscrews b adapted to screw on to the sides of a transmitter so as to support the disk a over the front thereof, and a large bent mouthpiece S carried by the disk. This monthpiece has a flange e, lying within a central chamber in the disk a and held in by flat ring f, which is screwed to the disk. Between the flange e and disk a a circular friction spring c is employed, so that the mouthpiece will stay in whatever position it is put. The single claim allowed is limited to a combination, including this spring. The broad idea will be very well remembered as it was commonly used with the old Blake transmitters in this country.

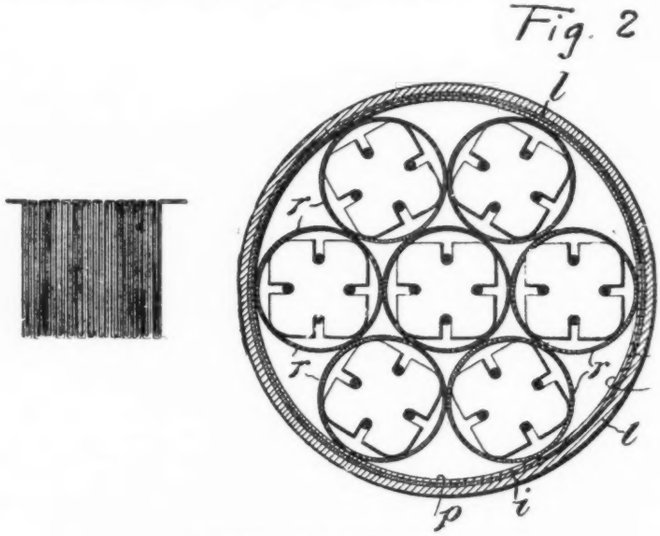
716,155—J. H. West, Electric Cable.

The invention in this case lies in the method of insulation of the wires in a cable, and its purpose is "to reduce the constants of the dielectrics." Instead of using the paper spirally wound about each conductor, as now commonly

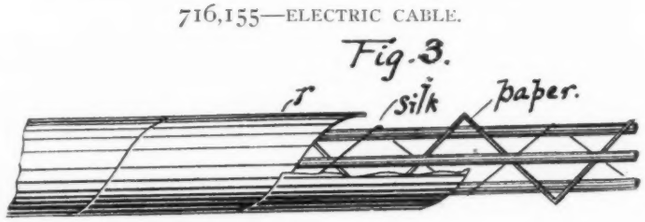


715,878—SWIVELING TRUMPET FOR TELEPHONES.

practiced, Mr. West takes a long strip of paper or other insulating material, and first folds it as shown in Fig. 1; then, with a circular saw or other device cuts notches in the edges and then feeds the paper into a machine which lays wires in the notches and also spreads the paper so that in plan or



716,155—ELECTRIC CABLE.



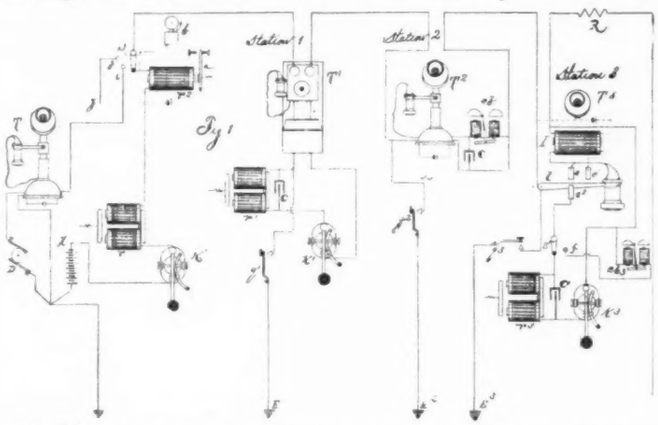
716,155—ELECTRIC CABLE.

edge view it appears as shown in Fig. 3. A silk thread is wound about the conductors and paper strip to hold them in place, and a paper sheath r is wrapped around the outside to form a tubular covering. Usually only two pairs are enclosed in one sheath, but he may use four pairs. A num-

ber of these two pair groups are then made up into a cable as shown in Fig. 2, having an outer covering of paper p, impregnated fibrous material i, and a lead covering l, if desired. It is obvious that while some difficulties, such as electrostatic capacity, may be partially obviated in such a cable, its size would be a great drawback.

716,186—C. E. Buell, Combined Telephone and Telegraph System.

There is nothing new in this system, which merely employs telegraph and telephone instruments at the different stations along the line, with suitable switches to cut them in and out. The principal station is shown at the left, and is provided with a relay r2 controlling the circuit of a vibrating bell b, main battery x is normally connected to line through this coil and the switch s. At any of the sub-

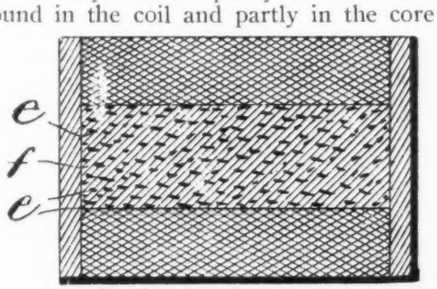


716,186—COMBINED TELEPHONE AND TELEGRAPH SYSTEM.

stations, No. 1, No. 2, No. 3, this relay and bell may be worked by means of the keys q1, q2, or q3, as the case may be. Signals may also be sent by means of the telegraph keys k-kl, etc., and none of these affect any of the sub-station receiving apparatus which is preferably controlled by polarized magnets, and is shown as consisting of ordinary ringers c. b.—c. b. 3. The main office is provided with the magneto machine D, to ring out over the line and signal the sub-stations, having a monopoly of this privilege, as they cannot call each other. This is reminiscent of some of Mr. Cook's work, and recalls also earlier systems of Black and Van Rysselberghe.

716,206—F. Dalezalek, Inductance Coil.

This invention relates especially to that kind of coils which are inserted in cables or long distance conductors to reduce the deleterious effects of capacity. In these coils it is of importance to reduce the loss of energy in the passage of current through the coil, caused principally by the generation of eddy-currents partly in the conductors themselves wound in the coil and partly in the core on which



716,206—INDUCTANCE COIL.

they are wound. The invention consists essentially of a coil wound with a large number of fine wires in parallel, and having a core composed of a mass of very finely divided magnetic material united by an insulated binding substance.

The core is formed of iron or other magnetic metal in the form of powder, as shown at e, in the figure, mixed with a substance like resin shown at f. Every single particle of iron is surrounded and separated from other particles by a thin but coherent film of insulating material, and the mass is shaped into form while in the plastic state, although it can also be machined after it has set.

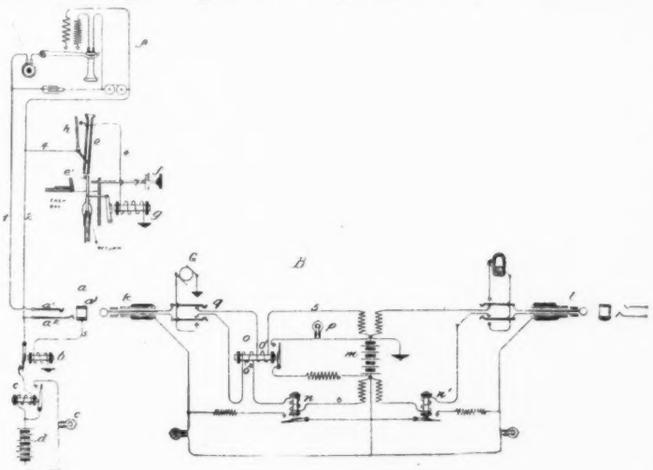
In laying on the winding on this core, a single wire is not employed as usual, but a number of fine wires in parellel. The number of the single wires and their cross-section is such as to make the sum total equal to or a little less than the cross-section of the single wire commonly employed. The Foucault currents generated in such a system will pass crosswise relatively to the length of the wire, and in order to effectually prevent their generation the single small wires or threads must be insulated from each other. It is found by experience that for the very small electro motive forces here dealt with that the natural film of oxide is a sufficient insulator.

It has been stated that the sum of the cross-sections of the fine wires may be less than that of a single wire for the same purpose, and the reason for this is as follows: It is well-known that alternating or pulsating currents are not equally distributed through the whole cross-section of a conductor through which they are flowing. But the current density is greater at the surface than in the interior. Therefore the ohmic resistance of a conductor is increased with the periodicity of the alternating current passing through it. For equal periodicities the ohmic resistance of a conductor will be diminished if the relation between the surface and the cross-section is diminished. In other words, a bundle of fine wires sufficiently insulated, having more surface than one larger wire may be assumed to have a greater conductive capacity than the single wire of the same cross-section.

This construction of core and winding is supposed to produce minimum losses.

716,293—C. E. Scribner, Supervisory Signal for Telephone Exchange System.

This is really a supervisory signal for toll systems, being intended to show to the operator that a coin has been deposited at the sub-station. The system illustrated in the patent is of the well-known relay type of the Bell company, employing a common battery d and m at the central office for signalling and talking respectively. The line 1-2



716,293—SUPERVISORY SIGNAL FOR TELEPHONE EXCHANGE SYSTEMS.

has the usual talking set and ringer at the sub-station A, and a springjack a at central line wire 2 is connected through the contacts of the cut-off relay b to the line relay c, main signalling battery and ground. The same wire is connected at the sub-station by a branch 4 to the switch h

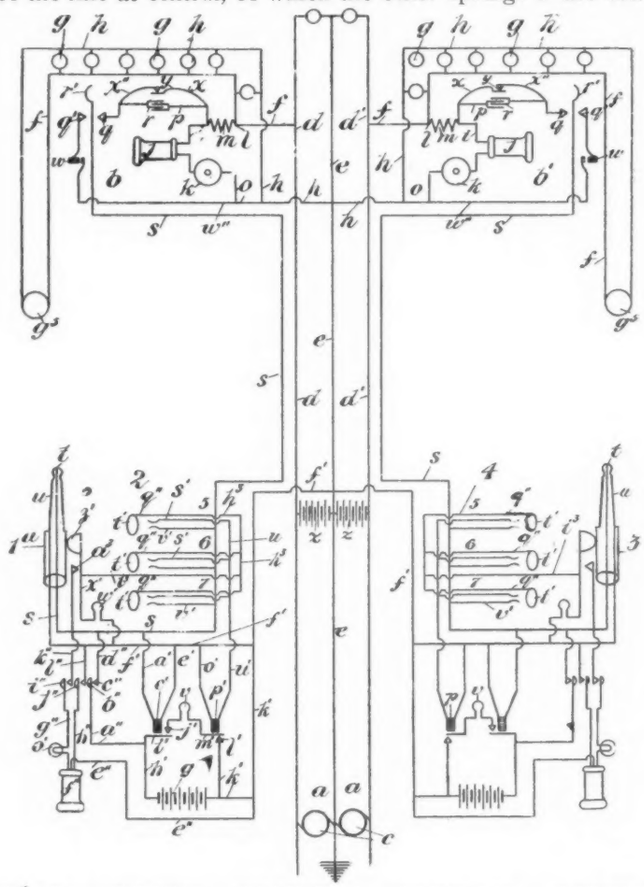
which lies in the path of a coin when the latter is inserted in the chute e. The branch wire passes to the magnet g and to ground. The coin in the chute, after closing the switch h, rests on top of the pivoted tongue e′, which is connected to the armature of the magnet g to be pulled over when the magnet is energized. The coin will then pass into the cash box. A push-button f may be used to force back the tongue so that the coin will return to the depositor.

The answering plug k and calling plug l are connected by the cord conductors 5-6, including two differential windings o′ and o2 of the relays o, of low resistance and low impedence, so as not to interfere with talking currents. Current in the metallic circuit produces a neutral effect and does not energize the relay, but current in the conductor 2, by itself, over the ground circuit, energizes the relay to close the local circuit of the lamp p.

When subscriber A desires a connection at the central office, he deposits in the coin chute e a suitable coin, which falls down until stopped by the deflector-plate e′, in which position it causes the closure of the ground branch 4 from the line conductor 2. Circuit from the line-battery d is thus completed through the line-signal relay c to the ground at the sub-station, the line-lamp c′ is lighted, and the operator observing the signal inserts her answering plug in the spring jack. The cut-off relay b is then excited by current from the battery m flowing to the third contact or sleeve of the answering-plug and thence to the ground through the conductor 3, the line-signal apparatus being thus cut off. When the answering-plug is inserted in the spring-jack, current from the grounded battery m flows out over the cord-strand 6 and the line conductor 2 to ground by way of the branch 4 at the sub-station. The supervisory relay n is excited and shunts out its associated lamp. The winding o^2 of the magnet o also receives current and causes said magnet to be excited, closing the local circuit, which includes the special signal-lamp p, so that said lamp is lighted to indicate that the coin is still present in the coin-chute at the sub-station. A portion of the cursent from the battery m instead of passing to ground at the sub-station by way of branch 4 returns to the central office over the limb 1 of the telephone line, which includes the winding o′ of relay o; but so much current is diverted to ground at the sub-station that the two windings o′ o^2 do not balance one another, and the relay attracts its armature in consequence. When the connection asked for has been made, the operator presses the key q, which connects the generator G to the limb 2 of the telephone-line, so causing the excitement of the magnet g. The valve e is thereby thrown to the right and the coin released and guided into the cashbox. If, however, the desired connection cannot be made, as when the line called for is busy, the operator will tell the subscriber to press the button f, and his coin will be returned to him. The pressing in of the button f throws the deflector-plate to the left, releasing the coin and guiding it into the return-chute leading to the outside of the tollbox. As soon as the coin is released from the chute the ground branch 4 is broken, and both windings o′ o^2 of the relay o in the plug-circuit receive equal current, so that the relay being differentially wound is deënergized and breaks the local circuit containing the signal-lamp p. The differentially-wound signal-controlling device o thus serves to inform the operator of the condition of the toll device at the sub-station. If the subscriber attempts to get back his coin while the connection is being made, the release of the coin and consequent breaking of the ground branch 4 will cause the extinction of the signal-lamp p, and the operator will take this as a signal for disconnection and pull out the plugs.

716,302—A. M. Stark, Combined Telephone Telegraph Electric Light and Power System.

The object of this invention is to furnish a subscriber with his electric light power, and telephone communication over one circuit; a represents the central station and b b′ the subscribers' stations. Connecting them is a three-wire circuit of two main wires d-d′ and a return e. From the main wire d to station b is a wire f with a return h to the wire e. Connected in parallel with these two are the lamps g and a motor g5. Bridged across the wires f-h are the transmitter k and receiver j, with a resistance m. Hook r′ is connected to a line wire s leading to the central office and there connected to the tip t of subscriber's individual plug u, and also to the signal relay c′. When the hook is down it rests on contact q′ and cuts in the subscriber's signal w, connected on the other side to the main return wire e. The line wire s is connected to one spring v′ in each of the multiple jacks of the line at central, of which the other springs s′ are con-



716,302—COMBINED TELEPHONE, TELEGRAPH, ELECTRIC LIGHT AND POWER SYSTEM.

nected to the common return u′, and thence through the relay p′ by wires o′ and f′ to the common return e. The test rings t′ are all connected together and to the plug seat switch x′. At the subscriber's station wires x and x″ form a telegraph circuit, with any desired telegraph instrument y bridged by a condenser r, the purpose of which is to prevent the interrupted current of a telegraph instrument being transferred to the receiver of a telephone instrument. When the switch-hook r′ is up it rests on a contact q, and the circuit from the central station is then from tip t of plug u, line wire s, hook r′, contact point u, wire p, wire i, receiver j, and transmitter k to return wire o, and main wire e, and also from p over the telegraph circuit. Telegraph messages are sent and received over the telephone circuit when the hook is in this position.

A storage battery z is bridged across the main power circuit to smooth out the current over the generators a-a.

In calling central, the receiver is removed from the hook r′ which engages the contact q and closes the line circuit to relay c′, which attracts its armature i′ and lights the lamp v.

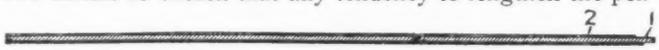
by current from battery g', the armature m' being normally back. When a plug is inserted in the jack the tip t engages spring s' and closes the circuit of relay p', extinguishing the lamp v. It also engages the line spring v' and establishes a circuit to the signallying device w, which continues to operate until the receiver is removed from the hook.

A clearing-out lamp w' is provided whose circuit is closed at the plug seat switch of the calling line when the plug is taken up, for use. This lamp remains lighted until the subscribers have hung up, its extinction signalling for clearing out. The operator's telephone f2 is cut in by a listening key of the ordinary type whose contacts are shown at i2, j2, b2 and c2.

The careful complexity of this system is quite equaled by that of the specification.

716,311—E. Thomson, Electrical Conductor.

The reader is probably familiar with the compound or compensating pendulum employed in the clocks ordinarily known as regulators. In order that the pendulum may remain of the same length at all temperatures, it is composed of two metals so chosen that any tendency to lengthen the pen-

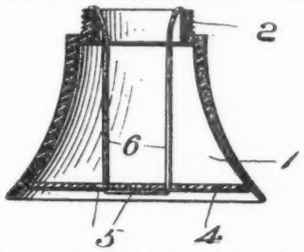


716,311—ELECTRICAL CONDUCTOR.

dulum will be balanced by an equal tendency to shorten it. The present invention employs a similar idea, covering a compound electrical conductor composed of elements whose materials have temperature coefficients of opposite signs. That is, if one element tends to increase its resistance by a change in temperature, the other element tends to decrease its resistance, whereby the resistance of the conductor as a whole is kept constant. In carrying the invention into practice a wire is formed with a core of material like copper, German silver, iron, or platinum, having a positive temperature coefficient, and over this core is applied a coating of certain alloys or carbon, having a negative coefficient. The core is shown at 1 in the figure, and the coating at 2. If the latter is to be of carbon it may be applied by heating the wire in a hydrocarbon gas, when the carbon will be deposited on the wire, until the desired thickness is obtained. The claims cover the subject matter broadly.

716,329—R. I. Willmarth, Antiseptic Protector for Telephone Mouthpieces.

This consists of a disk 4 made of absorbent material such as paper, saturated with a disinfectant like formaldehyde and

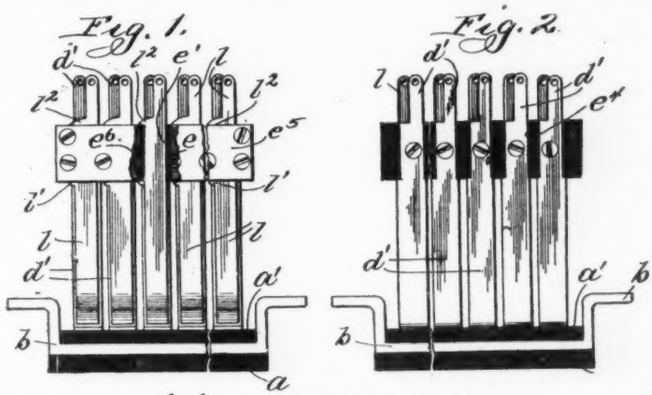


716,329—ANTISEPTIC PROTECTOR FOR TELEPHONE MOUTHPIECES.

fastened into the opening of the mouthpiece by a wire clip 6, having hooked ends. The disk is perforated and the wire passes through two of the perforations.

716,460—W. E. McCormick, Multiple Switchboard.

The invention here is in a strip of jacks forming one unit in the equipment of a multiple board. In the figures herewith Fig. 1 is a top view, Fig. 2 is a bottom view, and Fig. 3 is a sectional view of a strip. Generally speaking, the design is the usual one, having a front strip carrying test terminals, a rear strip carrying the jack springs, and a fastening strip insulated from everything else. The differences are in detail. Referring to Fig. 3, e is a strip of insulating material (rubber, let us hope), milled out on upper and lower faces into channels to take the springs l and the test ring stems d', respectively. The springs l have ears l2 formed on them to keep them from lengthwise displace-



716,460—MULTIPLE SWITCHBOARD.

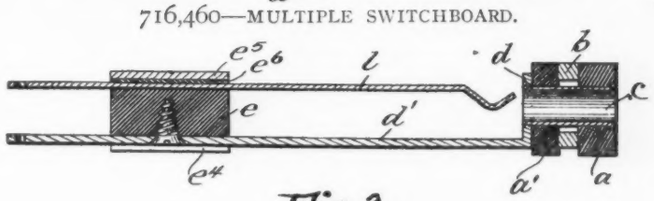


Fig. 3.

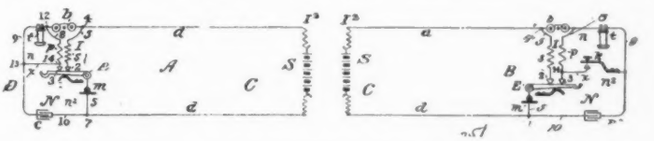
716,460—MULTIPLE SWITCHBOARD.

ment, and are held in place by an overlying strip of insulation e6, and a metal strip or stiffener e5. The stems d' are held into the channels by screws, and serve to connect the front and rear strips. The front strip consists of two parts, a and a', between which lies the fastening strip b, of metal. The parts are clamped together by the row of test rings or thimbles c, which have flared front ends, and are screw-threaded at the rear to make connection with the upturned ends of the stems d. The fastening strips b extend out at the ends of the rubber strips a-a' and are suitably formed to be secured in the board, as shown in Figs. 1 and 2.

716,779—A. B. Stetson, Telephone Transmitter Circuit.

This is an arrangement of the subscriber's circuit in a central energy system such that the objection of side tone, which when high tension talking current is used becomes a serious one, is removed or substantially so. There is nothing broadly new in the device, which consists in shunting the transmitter as of old, when receiving, with such changes in connections as the use of the Bell common battery circuit requires. It takes three thousand words of specification to tell the story, however.

In the figure, S S is a centralized battery, bridged across the circuit a-d with a repeating coil, as usual. At the subscriber's station the battery current flows through the secondary s of the induction coil, through the transmitter m and back to central. A local circuit also includes the transmitter as follows: wire 5, wire 10, condenser N, wire 9, receiver t,



716,779—TELEPHONE TRANSMITTER CIRCUIT.

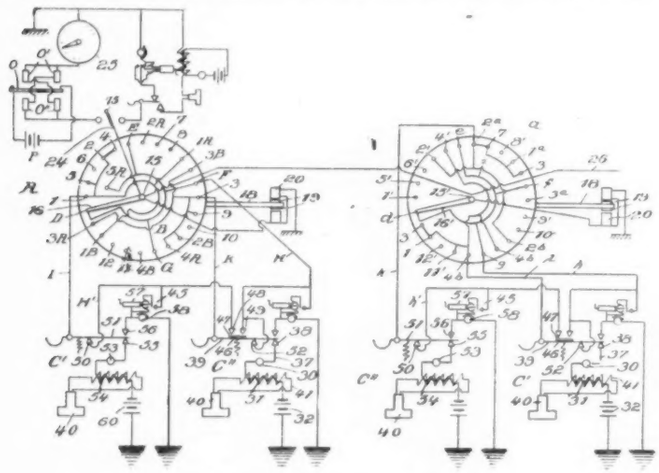
wire 8, primary p, switch-hook E, and so back to the transmitter. When the latter changes its resistance, there are surgings set up in this local circuit, which correspond to the voice changes, and which are propagated into the main line a-d through the secondary winding s.

When high potential sources are used at S, the side tone is

said to be very annoying, and as the transmitter is sensitive the noises in the immediate vicinity also cause disturbances while listening. To prevent this the key k is provided, closing a bridge or short circuit x around the receiver and primary coil. Thus the current changes in the main line can be inductively reproduced in the local circuit 8-9-k-p, containing the receiver, while the transmitter disturbances will be limited to the circuit 5-10-k-x-E.

716,802—W. C. Wright, Telephone System.

This purports to relate to automatic telephone exchanges, but the rotary switches are worked by operators. Subscriber's stations are shown at C′, C″, etc. The central office boards are indicated at A-a. At each point is a sunflower switch, with its central rotary arm normally resting on one of four equidistant connected "signal" contacts, D-E-F-G, or d-e-f-g. When a subscriber wants a connection he rings up by means of a direct current generator 57 at his station, the current passing to central and alarming the operator, presumably through the switch 75 and the circuit above it. By a thoughtful arrangement the stations C′ and C″ have their switch-hooks connected in series on the wire H, so that



717,802—TELEPHONE SYSTEM.

if C″ is in service, C′ is effectually shut out. The subscriber having called the operator, advises her over the signal wire of the connection desired. The switch-arm 16 is then set around to the required contact by the operator. It seems C′ and C″ can converse over the signal circuit, either of them can get the subscribers on board a over the wire 26, and by setting the arm 15′ on a dead point l′ through connection can be afforded to "points beyond."

Each switch has an escapement mechanism composed of a verge rod with teeth on one end on anchor arms, and an armature on the other lying between magnet poles to be vibrated when alterations are sent through a circuit not plainly seen. The operator is provided with a pole changer o-o′-o″ for the purpose of operating this beautiful novel piece of mechanism, when manual operation becomes too tiresome. It may also be operated from a distance, or so it is stated.

DECEMBER 30TH.

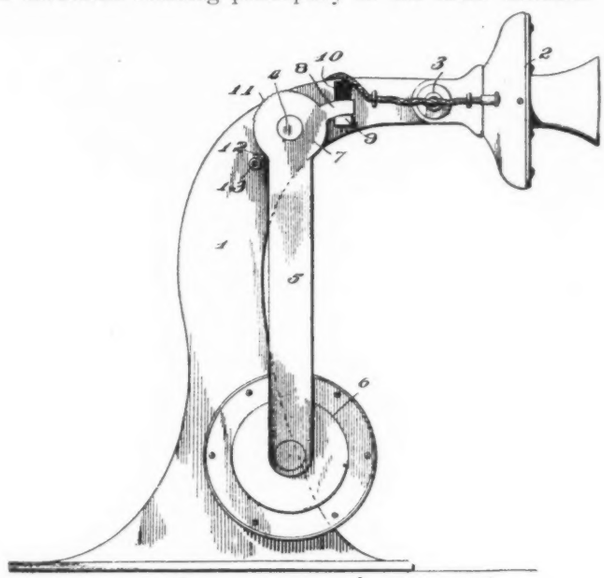
717,218—T. C. Knowles, Telephone Transmitter.

This device comprises a goose-neck hollow arm, a switch within the arm, a receiver holder pivoted on the side of the arm, and a finger on the holder to work the switch when the receiver is raised; 1 is the goose-neck; 2 is the ordinary transmitter; 9 is the projecting end of the switch, the body of which is supposed to be inside the arm; 5 is a holder arm pivoted at 4 and carrying a receiver 6, and having a finger 8 overlying the switch end 9; 11 is a ratchet on the holder, co-operating with the fixed spring metal pawl 12 to hold the arm 5 up when the receiver is in use.

The apparatus is shown in the position of disuse. When the receiver is raised the finger 8 permits the switch 9 to rise, closing the talking circuit.

717,300—W. A. Taylor, Current Protective Device.

This is a combined lightning and sneak current arrester, the invention residing principally in the latter element. It



717,218—TELEPHONE TRANSMITTER.

is the property of the Kellogg Switchboard and Supply Company.

In most sneak current arresters heretofore used, a connection is made in the circuit by means of easily fusible material like soft solder, and a heat concentrator of the nature of a coil is included in the circuit and located in close proximity to the fusible connection. In the present case no coil

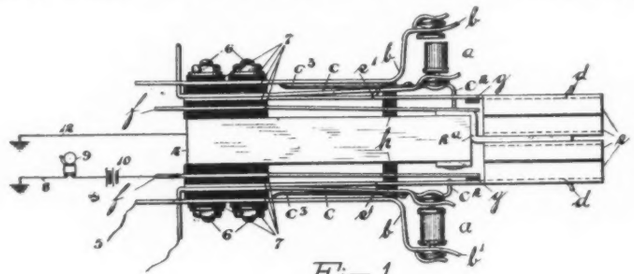


Fig. 1.

717,300—CURRENT PROTECTIVE DEVICE.

is employed, but a carbon rod a is provided instead, having caps a2 soldered to the copper-plated ends. This rod, with its caps, is shown in Fig. 2, and the mounting with the con-

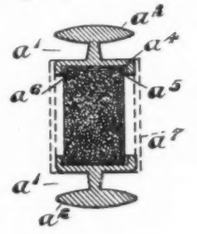


Fig. 2

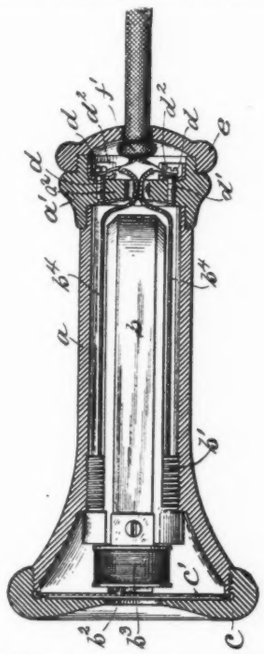
717,300—CURRENT PROTECTIVE DEVICE.

tact springs and the carbon lightning arrester terminals, is shown in Fig. 1. The carbon heat concentrator is held between springs b and c, under tension, so that when heated

by a sneak current one or both caps will be pulled away, and the circuit opened. The carbon blocks e are held between springs d and the contact 2a, having interposed mica separators, as usual. When a line circuit is opened by the sneak current arrester the springs f-f are adapted to be inindividually forced against the part 2, closing the signalling circuit 8-9-10-2-12. Stud h maintains the outer pairs of springs at the proper distance, passing through holes in the others.

717,429—K. B. Miller, Telephone Receiver.

This receiver patent is also the property of the Kellogg Company. The usual rubber shell is employed, formed with a screw thread inside the cup end, to receive a correspond-



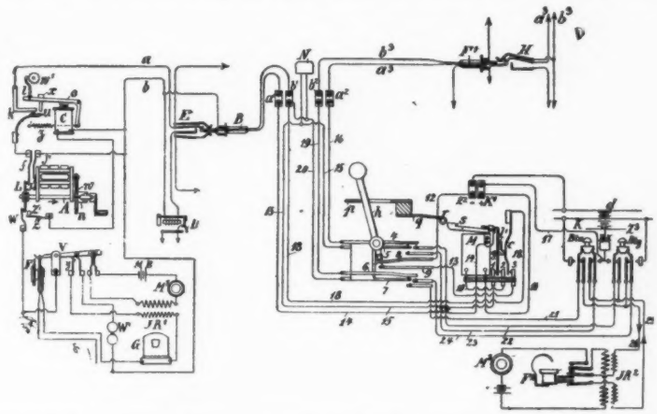
717,429—TELEPHONE RECEIVER.

ing threaded part on the magnet, b'. This supports the magnet within the shell. At the rear end the shell has a transverse partition, a2, with a single central perforation through which the conductors b4 are led, the magnet being thus capable of being turned without twisting the conductors. The cord connections are made at d' d', on the outside of the partition, being covered by a cap e screwed on the shell.

717,755—J. H. Meyer, Automatic Conversation Counter for Telephone Exchange Systems.

Mr. Meyer is a subject of the German Emperor, residing in Madgeburg. His arrangement, here presented, is ingenious, but it is completely out of the line of American practice. Any extended description of the entire system will be impossible, although the appreciation of the counter will hardly be understood without it. There are six sheets of drawing. It will be remembered that in the German systems six separate operations must be gone through by the subscriber to obtain a connection, and the time consumed is something fearful according to our notions. In the present case the calling subscriber has the desired line given him, and does the ringing and supervising himself. A central battery is provided for the register, but all calling is either by local hand generators or by push-buttons. "Stock" keys are referred to, which are foreign to our systems.

In the figure herewith, the subscriber's station is shown at the left, the central station at the right. The subscriber calls by means of the hand generator A, on whose shaft is the usual cam producing endwise motion of a contact disc L normally resting on the contact W to complete the bell circuit W'. The circuit in calling in is this: A-J'-b-D-a-k-u-f-L. Drop D falls and operator inserts answering plug B. The listening key h is then pushed to the right to cut in the operator's set M2, F2, and the number wanted ascertained. In moving the key through the last part of its path armature s of a relay M is depressed, closing the springs to-



717,755—AUTOMATIC CONVERSATION COUNTER FOR TELEPHONE EXCHANGE SYSTEMS.

gether that control the circuit of the register battery d, but until the subscriber performs an act this has no effect. Having inserted the calling plug F' in the wanted jack, the operator throws the key h again to the left, and in so doing roller r pushes down armature s, the circuit from battery d is closed through the cord springs to the plug contacts and over the line through the circuit traced for calling. The armature of the relay M is then held down by the passage of this current, and as the subscriber has his receiver off the hook the current passes to the "indicator" at B (bottom of the figure), which displays the polite request "please call." The subscriber, being thus informed that the connection is so far complete, turns his crank, the disc L is retracted as before stated and as it moves it closes momentarily with the spring contact Z', permitting current to pass from the central battery to the register magnet C, which thereupon chalks up the call. At the same time the armature o in moving down opens the circuit at u by means of the pin x, and the relay M at central instantly lets go its armature, closing the through cord circuit, which had before been open, as can be ascertained by tracing out the connections. The subscriber can now at length ring through to his wanted correspondent, unless the operator desires to assist him when there are sundry other evolutions of a cumbersome nature to be performed.

The relay M and its connections are somewhat reminiscent of a disabling device in the cord, recently patented to Mr. Dean, his subscriber being unable to talk through until the count is made, but the advantage is all this way in regard to simplicity and elegance of design..

717,778—R. Spaulding, Electric Conducting Cable.

This is another cable case bearing on similar matter to that presented last month. Mr. Spaulding's first claim will best give the scope of the invention in this case:

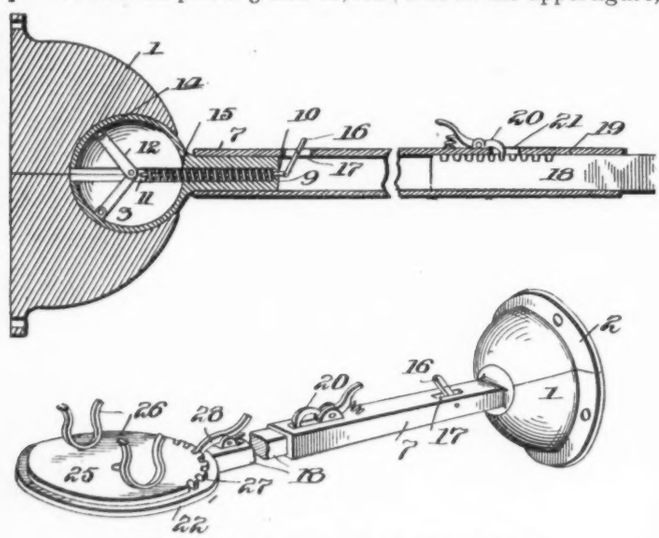
717,778—ELECTRIC CONDUCTING CABLE.

"An electric conductor-cable comprising a braided core and an insulating covering."

There are four more claims, all rather broad. The wire is laid up in strands, and the strands braided.

717,895—J. B. McClain, Telephone Receiver Holder.

The name indicates the function of this device. The base 1 contains a ball-and-socket joint, the ball of which carries the hollow arm 7, within which telescopes the rod 18, carrying on its end the disc 22, upon which is pivoted the rotatable disc 25 carrying the clips 26 in which the receiver is placed. The joint in the base is ordinarily kept rigid by a pair of friction pieces 3 and 12, seen best in the upper figure,

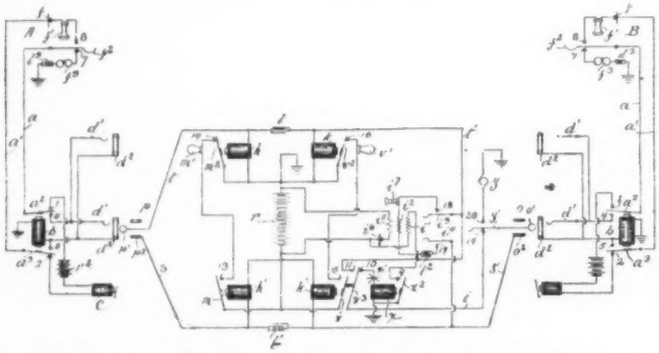


717,895—TELEPHONE RECEIVER HOLDER.

which press the split halves of the ball outward against the socket. These friction pieces are controlled by a thumb piece 16, against a spring 15. The rod 18 has ratchet teeth 19 into which takes a pawl 20 through a slot 21, to keep the rod set as desired. The movable disc 25 also has ratchet teeth 27, a pawl 28 taking therein. Thus all sorts of adjustments may be attained and maintained.

717,973—W. W. Dean, Testing System for Telephone Lines.

This is a special test arrangement for the Dunbar two-wire multiple system. In such systems as heretofore used, the test rings are normally disconnected from the lines and also from any source of current, so that if the tip of a testing plug is applied no click will be produced, because



717,973—TESTING SYSTEM FOR TELEPHONE LINES.

of no potential difference from the ground. If a line is in use, however, the main battery is connected, and a portion of the current is diverted directly to the operator's receiver, producing a click that is frequently objectionable to the operator, and moreover disturbing the busy subscriber, owing to a portion of his talking current being diverted. In the present case Mr. Dean uses a relay to test the line, its armature controlling a local circuit connected with the operator's head phone, the relay being of high resistance and impedance, thus shunting insufficient current to disturb the subscriber, and producing a graduated click, adjusted to be loud or low, as desired. One relay may serve for all the cords of one operator, or a separate relay for each cord may be employed.

In the drawing herewith a a are the line wires, connected to the ordinary apparatus at the sub-station A, and to the relay springs a2 a3 at central, which complete the normal calling circuit to the battery r2 and the signal c. The springs d′ of the jacks are normally disconnected from the line, and the test rings d2 are disconnected from line but connected to ground through the relay b. The answering plug p and calling plug o are connected by the cord conductors s-t-s′-t′, interrupted by the condensers l′ and l. The conductor t′ is also interrupted by the open contacts 11-v3 under the control of relay k′. The main battery r is bridged across the cord conductors by branches to the opposite sides of the condensers, each branch containing a relay, h-h′-k-k′, controlling the supervisory lamps m′ and v′. In the idle condition shown, with the armature v back, the contact v3 is closed on the contact 10, the tip o′ of plug o being thus connected through the conductor t′ to the relay x and to ground. This relay x controls a local circuit from ground through armature x2 to point 9, to the third winding i′ of the operator's induction coil, to the main battery r and to ground. The resistance of this circuit may be made of any suitable or desired magnitude, to regulate the click due to a busy line.

In calling the subscriber A takes down his telephone, and signal c is exhibited. The answering-plug p being inserted in the jack, current passes from battery r through relay h′ and conductor s to the relay b, which thereupon pulls up the springs a2-a3, and so cuts off the signal c and puts the line on the jack. Relay h′ also closes its break in the circuit of lamp m′. Having ascertained the number wanted, the operator touches the tip of plug o to the desired jack, and if the line is busy current comes back from the sleeve through conductor t′ to the relay x and to ground. The relay x being of very high resistance, and many turns in its winding, pulls up its armature with but a trifling abstraction from the current in the busy line, and as it does so the circuit of the third winding i′ in the operator's coil is closed, producing the characteristic click. If the line is idle no current passes, and no click is produced.

The line being idle, the plug o is fully inserted in the jack, whereupon the relays k′ and b are in closed ground circuit with the main battery, and the armature v cuts off the relay x, and connects the broken cord sections t′-t′; while the armatures a2-a3 connect the wanted line to its jacks. The ringing key g′ then comes into requisition as usual.

As long as the telephones are in use, current in the metallic circuits energizes the relays h-h′-k-k′, and the supervisory lamps remain dark. When the telephones are hung up relays h and k are deënergized, and lamps m′ and v′ light. When the plugs are withdrawn from the jacks these relays permit their armatures to fall back, but then the other relays, h′-k′ also let go their armatures, so the lamps become extinguished and remain so as long as the apparatus is idle.

JANUARY 13, 1903.

718,093—H. P. Clausen, Telephone Jack.

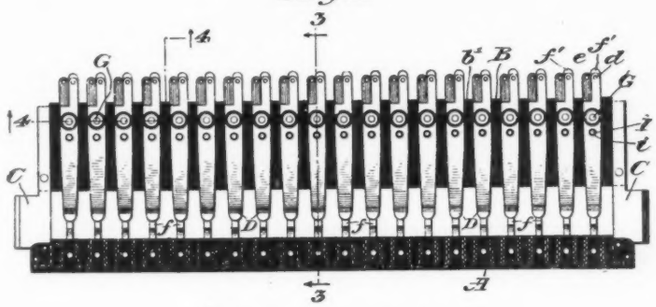
This is another strip of multiple jacks. The frame consists of front and back strips, the front strip A of rubber, drilled for the test rings, and the back strip B of metal with rubber facings and the springs bolted to it. The end pieces C connect the strips and furnish fastening means. Figure 3 shows the manner of securing one set of springs. B is the metal strip, with the rubber facings b′ b2. The springs D and E, and the stem H of the test ring are laid across the strip, on the rubber, and held in place by a bolt G, bushed with rubber; the springs being duly separated from each

other by rubber strips. Steady-pins I are employed to keep the springs aligned, these also being bushed, to insulate them.

718,204—M. R. Hutchinson, Telephone.

This is a granular microphone of the old "Universal" type, having its diaphragm kept horizontal and the granular

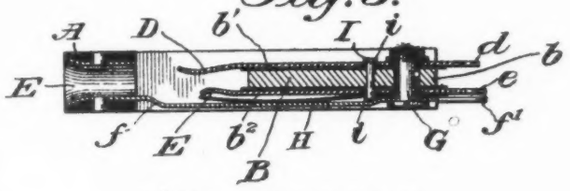
Fig. 1.



718,093—TELEPHONE JACK.

material lying loosely above it in a layer. The diaphragm B carries on its upper side a series of electrodes a-b-a'-b', ar-

Fig. 3.



718,093—TELEPHONE JACK.

ranged close to each other but mutually insulated. A covering of felt or cloth, f, forms an enclosed space above

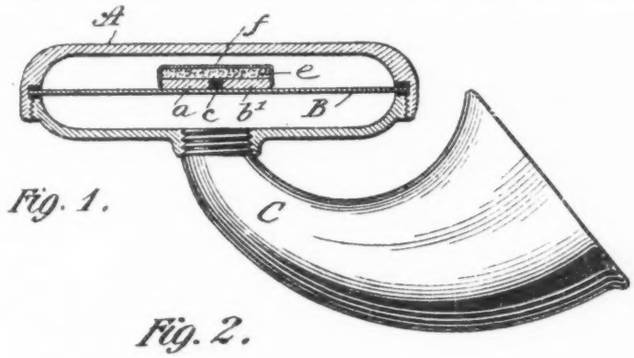
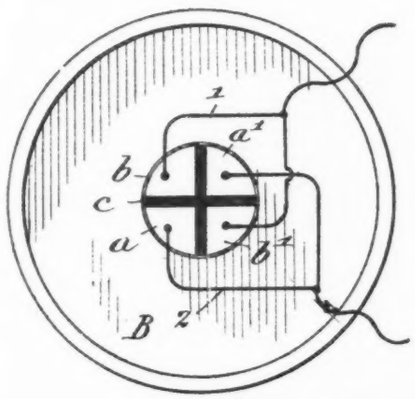


Fig. 1.

Fig. 2.

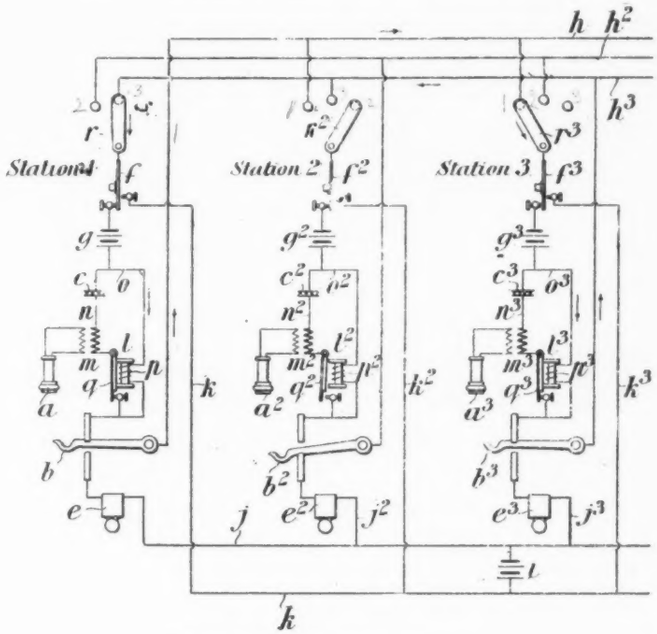


718,204—TELEPHONE.

the electrodes, in which, and resting on their upper surface, is the granular material e. The electrodes are laid in non-conducting cement. It is obvious that the instrument must be used in the position shown, and the mouthpiece is therefore shaped accordingly.

718,215—I. H. Parsons and T. Sloper, Telephone System.

This is a very ingeniously designed intercommunicating system, in which the secrecy of communications is absolutely assured. Each station has receiver a, transmitter c, bell e, switch-hook b, induction coil n, talking battery g, calling key f, selective switch r, and privacy relay l. The bells e



718,215—TELEPHONE SYSTEM.

are all connected on one side to the common return j, and the calling wires k are all connected to another common return k, and between these common returns the signalling battery i is abridged. Each station has an individual wire, which is connected to the switch-hook of its own apparatus, and to a contact of the selective switches of all the other stations.

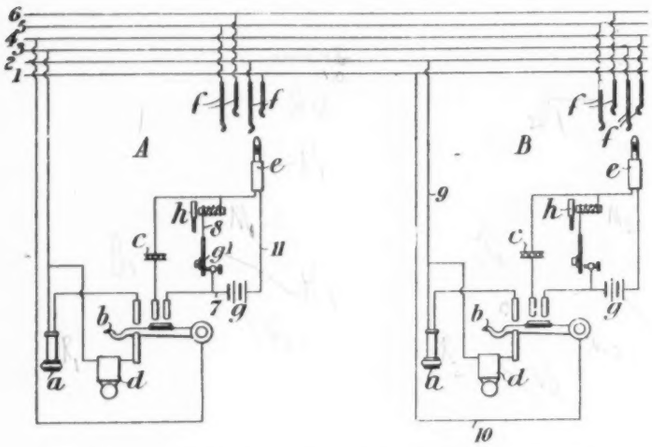
Suppose that station 1 desires to call station 3; the user first sets the switch arm r on the middle contact as shown, then depresses his calling key f. Current flows as follows: battery i, k, f, r, line wire, individual wire to switch-hook b3, to bell e3, wire j, and back to battery. The caller then takes down his receiver and listens, although his receiver and transmitter are not yet in circuit, as their branch is broken at the contacts q of relay l. The party at station 3, hearing the bell ring, takes down his phone, but finds this also cut out, and he then moves his switch-arm r3 around over the contacts until he hears a click, which is also audible to No. 1, and indicates that a complete circuit has been formed for the talking batteries, as follows: battery g, switch r, line wire, switch-hook b3, relay l3, wire o3, battery g3, switch r3, line wire of station 1, and to the switch-hook of that station b, and so to the relay l and battery g. Both relays then attract their armatures and cut in the talking instruments, thus giving the click. No third party can cut in, for each one controls only his own line, which is but one-half of the circuit, nor can he ring, the engaged parties, because their bells are cut out. This co-operation of the stations in making the connection simplifies the circuits, while all the usual objects seem to be attained, in addition to secrecy.

Modifications show magneto ringing, etc.

718,224—T. Sloper and I. H. Parsons, Intercommunication Telephone System.

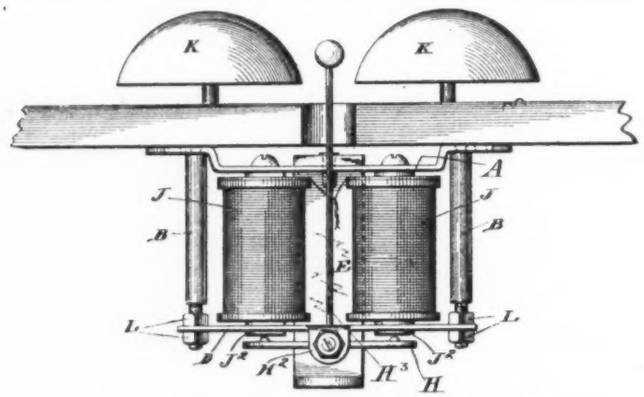
This is another system by the same inventors, involving an idea quite as ingenious as that in the other case. Here each station in the system has a pair of home wires extending to all the stations, and each has its receiver connected permanently in its own home wire, while the transmitter is in a plug cord circuit that can be connected in any other circuit. It is thus obviously impossible for any party to listen in on a conversation, as his receiver cannot be shifted to the lines in use.

In the figure herewith, g is the battery in the transmitter circuit, and 1, 2, 3, 4, 5 and 6 represent the home lines with which receivers of the different stations are connected, the jacks f, f being also connected to these lines as shown. With



718,224—INTERCOMMUNICATION TELEPHONE SYSTEM.

this arrangement when an operator at, say, station A, desires to call up station B, he places his plug e in the jack f of line 1-2, and depresses the key g', whereupon current flows through wire 7, contact g', wire 8, plug e, jack f, line 2, wire 9 at station B, bell d, receiver hook b, wire 10, home line 1, jack f at station A, plug A, plug e and wire 11 to battery. The bell at station B then rings, and the operator removes his receiver from the hook, thereby placing it in circuit with the transmitter at the calling station A, the opera-



718,235—POLARIZED TELEPHONE SIGNAL BELL.

tor at which station can then announce his number. (He knows when the connection is complete by the stopping of the buzzer h in the ringing circuit.) Upon hearing the number of the caller the party at station B plugs in on the home line of station A, and his transmitter is thus brought into connection with the receiver at station A.

Thus the receiver at each station is in connection only with the transmitter at the other, that is to say, with the station that has plugged in on its home line, and obviously no third party can listen in, for his receiver is limited to his own circuit.

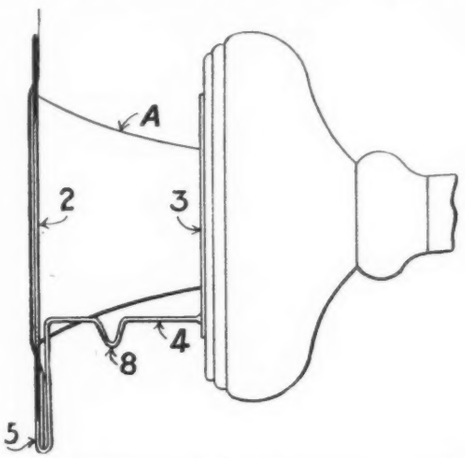
Modifications show magneto ringing, etc.

718,235—E. E. Yaxley, Polarized Telephone Signal Bell.

This is the well known American electric ringer. Side posts B-B outside of the magnets carry the yoke D, through which the magnet cores J2-J2 project. Double nuts L on the side posts, which are threaded, serve to adjust the yoke and hold it in adjustment. The armature is carried bodily on the yoke and of course adjusted with it.

718,264—J. F. Logue, Attachment for Telephone Mouthpieces.

This is another antiseptic attachment. A flat ring 3 is held against the front plate of the transmitter by the mouthpiece A when it is screwed in, and carried by this ring is a

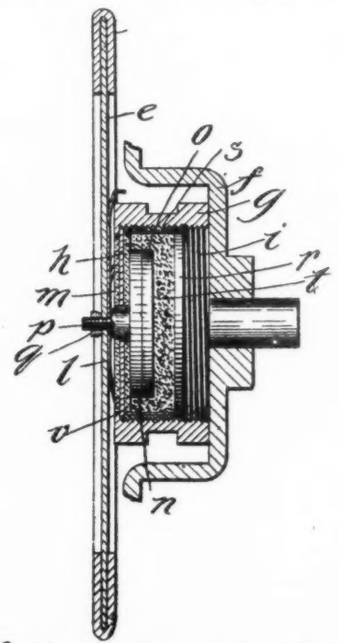


718,264—ATTACHMENT FOR TELEPHONE MOUTHPIECES.

bent wire clip 2-5-8-4, extending in front of the mouthpiece. A sheet of paper is slipped into this clip to cover the opening of the mouthpiece.

718,310—C. C. Cadden, Telephone Transmitter.

This is a transmitter of the solid back type, using a diaphragm with the well known rubber gasket d, and a bridge



718,310—TELEPHONE TRANSMITTER.

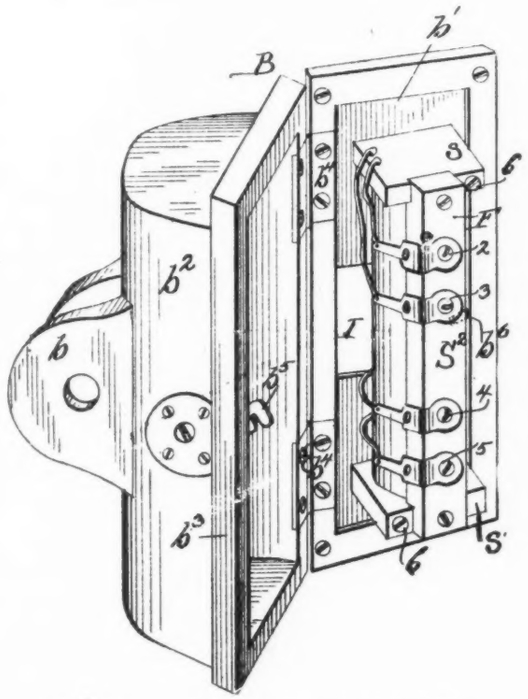
f, but having the chamber and its parts varied somewhat.

In the figure g is the chambered block, screw threaded within, and provided with a circular lip on its front edge, m. The front of the chamber is closed by a perforated head h, through which the stem p of the front electrode passes. Inside and out of this head h are arranged discs of fabric v and m, which serve to insulate and also to cushion the electrode. Between these and the diapragm is a spider l of spring metal which not only keeps the front electrode up against its cushions, but serves to make connection thereto, by means of a tail. The rear electrode is carried on a stem extending through the bridge as usual, and is screw threaded into the chamber, coming up against a distance ring s, which is lined with paper and serves also to hold in the front head h.

718,371—W. E. McCormick, Coil-box for Telephones.

In the coil boxes heretofore used the transmitter arm is pivotted on the front of the box, and the latter is fastened once for all to the back-board. The terminals are outside, and the only way to get at the coil is to unscrew the box from the board. In the present case, Mr. McCormick seeks to improve these conditions.

The invention consists essentially of a fixed base carrying the coil I, and a box or cover of the usual pattern hinged



718,371—COIL BOX FOR TELEPHONES.

at one side of the base to swing open and closed as desired. On the front of the coil is arranged a terminal strip F, with all the terminals accessible, but protected when the box is closed. A fastening device b5 serves to lock the box when closed. By this construction a coil can be inspected as often as desired without trouble.

The transmitter arm is not shown, but is supposed to be pivoted on the lugs b of the box.

ELECTRICAL SILKS.

BY CHARLES LINCOLN BURLINGHAM, B. S.

Among users of silk-covered magnet wires there are probably few who are familiar with the history of the silk used for this purpose or have any knowledge of the limited district that produces silk of a quality that can be utilized for this purpose. From a comparatively small district in Italy comes that special grade of "Italian" used for the insulation of fine wires, and this relatively small area owes its pre-eminence in the production of fine filatures to special climatic conditions.

Tram, the trade name for the silk used on magnet wires, is produced from this stock, and its fineness can be best judged when it is stated that the thread in the raw state will run over twenty-eight thousand yards to the ounce, or approximately two hundred and sixty miles to the pound, a distance nearly as great as from Chicago to St. Louis. These figures are for the highest grade of stock and would not apply to silk from other localities.

The silk-raising industry is conducted by the peasants, and as the cocoons are practically an everyday crop, the greatest care and attention are required in the development of the silk worms, which at maturity spin the cocoon resembling the shell of a large peanut. In this state the temperature is an important factor, as any sudden chill is liable to kill thousands of the worms, entailing a total loss.

The worms pass to the chrysalis state and from that to the moth, which, after a certain period, eats its way out from the cocoon, the female laying a large number of eggs and then dying. These eggs, passing through successive stages, develop ultimately into the matured worm ready to spin a cocoon, and this transition period occupies about seven weeks. The silk worm, for its size, is among the most voracious forms of animal life, feeds upon mulberry leaves and after a period spins a cocoon.

The commercial cocoon is taken after the worm has passed into the chrysalis state and is subjected to sufficient heat to destroy life and prevent further development. The cocoons now pass to the winders, a grade of work generally performed by women, who place the cocoons in warm water to soften the natural gum, equivalent to about twenty-five per cent of the total weight. The fine filament or thread is then picked up with four or five others, according to the size of strand desired, and is carefully reeled into a skein and after being reeled again is put into hanks, so many forming what is known as a book and so many books a bale.

The silk is now ready commercially for the manufacturer, who takes this stock, doubles and spins it and then removes the natural gum by boiling off, leaving the silk in an absolutely pure state and ready to be wound into any desired shape required by the insulator. Many attempts have been made to find a suitable substitute for the "Italian," but so far there has been only failure, for no other stock gives the desired smoothness to the finished wire.

In the making of tram it is essential that the silk be perfectly pure, in order to get the greatest results from a given unit of silk.

Tussah, the wild silk, from the jungles of India and China, is of coarse, rough texture, unsuitable for the finer grades of insulation, but admirably adapted for the insulation of switchboard wires and similar work around telephone installations on account of its non-transmission of external noises, a quality tussah possesses to a more marked degree than any other fibrous substance.

The silks used for braiding purposes are not of as high grade as is necessary for the production of tram and are generally produced from China stocks, subjected to different processes, in order to produce the different kinds of threads wanted in floss or twist.

Spun silk is a carded silk, produced from the punctured cocoons, and from this stock is produced a silk that is as suitable for certain grades of work, such as cords, as the regular stock.

America has never been commercially successful in the cultivation of silk on account of the price of labor, the low rate of the foreign laborer operating against this country, though some parts of the United States, notably southern California, are well suited for this particular industry.

DECISIONS AFFECTING TELEPHONY

Conducted by ANDREWS & MURDOCH, Berrien Springs, Michigan.

INTERFERENCE BETWEEN COMPANIES.

In the case of the Chicago Telephone Company against the Northwestern Telephone Company, for the purpose of enjoining the latter from interfering with the poles, wires, and telephone system of the former in the streets of the city of Aurora (65 N. E. Rep. 329), the defendant denied the interference alleged, and claimed the right under an ordinance of the city of Aurora to itself construct a telephone system in that city. In affirming a decree for defendant, the supreme court of Illinois holds that an ordinance granting a privilege to a corporation being accepted and acted on becomes a contract, the validity of which cannot be questioned by one not a party thereto. A grant or right to a telephone company to establish a telephone system in the streets subject to the power to grant a like right to another company, so as not to interfere with the right granted to the first company, protects it only against unnecessary and unreasonable interference. The placing of wires of a telephone company in the streets as directed by the city will not be enjoined at suit of a prior occupying telephone company unless the power of the city is abused to the oppression of the complainant. The danger to a telephone company from the breaking of wires of another such company is so remote that placing of the wires of the later occupying company above those of the prior occupying company will not be enjoined.

In the course of the opinion the court says: "The material question is whether, under the evidence in this case, the appellee has so used and constructed its telephone system in the streets of the city of Aurora as to interfere with the right of appellant to erect and use its system of telephones. It necessarily results from the fact that the city has a right to grant the privilege of operating a telephone system to different companies, that there will necessarily be some interference by the company with another. Wherever telephone companies occupy the public streets with their poles and wires, there will, as a matter of course, be some interference between them. The thing to be guarded against is such an interference as will prevent the practical operation of any one telephone system. In other words, it was and is the duty of appellee so to construct and use its telephone system as not unnecessarily and unreasonably to interfere with the operation by appellant of its system. To grant any one company the exclusive right to use the streets would be to establish a monopoly. Joyce, in his work on Electrical Law (section 517), says: 'Upon the question of interference by the electric light wires of one company with the wires of another electrical company, the following general rule may be stated, being clearly sustained by the weight of authority. As between an electric light company and another electrical company, whether that company be a telegraph, telephone, or an electric light company, prior authority to occupy, or prior occupation of the streets, will not confer upon such company an exclusive right. The right of the prior licensee, however, must not be substantially invaded by the later company. Such subsequent licensee is under the duty to so maintain its wires and lines as not to interfere with the right of the prior occupant of the streets to properly maintain and operate its lines, and to transact the business it is authorized by its franchise to transact.'" In the recent case of Louisville Home Tel. Co. vs. Cumberland Telegraph & Telephone Co. (decided by the federal circuit court of appeals for the Sixth circuit), 49 C. C. A. 524, 111 Fed. 663, where a telephone company constructed its line in the streets of a city under a franchise granted therefor, which expressly reserved the right to the city to grant similar rights to other companies, and thereafter a franchise was granted to a second company, which was required to construct its line under the direction of the board of public works, and such board required its line on certain streets to be placed on the same side and over the same space occupied by the first company, it was said by the court: "The circuit court appears to have accepted as correct the contention of the complainant that by its prior occupation of the space which it occupied by erecting its poles, cross-arms, and wires over a width of eight feet and at the height of twenty-five feet, it acquired an exclusive right to occupy that width of space from the ground upward without limitation, and this without any intrusion by another party. * * * In this the court misconceived the nature and extent of the rights of the complainant. It may properly be conceded that its prior occupation of space, under the franchise granted by the statute and ordinance, would entitle it to continued enjoyment thereof, so long as it continued to perform its obligations, without substantial impairment. But its right is not absolutely exclusive. It is subject to such incidents as result from the exercise of the rights of other parties who have acquired a valid franchise of similar character. It is implied in such grants as were here made to the first company that the grant is subject to such limitations as will enable another company to enjoy a like franchise, and no property right is invaded by the adoption of such measures by the second company as will enable it to exercise its privilege, provided there is no unreasonable and unnecessary invasion of the operations of the first occupant. For the property right of the first is not to a monopoly. It is bound to exercise its privilege in such a way as to give room to another coming in under the power reserved. In the present case the common council of the city expressly reserved the authority to grant to others, if it should deem it for the public interest, the same privileges in its streets as it granted to the complainant. * * * It is not intended, of course, to say that the first occupant may be despoiled, or the substance of its right appropriated. But this does not happen from merely giving place to a rival company, whose presence was expressly stipulated for by the contract, nor, probably, if the presence of the new party was the result of the exercise of a power reserved by implication in such a grant of privileges." Cumberland Telegraph & Telephone Co. vs. United Electric R. Co. (C. C.), 42 Fed. 273, 12 L. R. A. 544; Rocky Mountain Bell Tel. Co. vs. Salt Lake City Ry. Co. (Utah), 3 Am. Elec. Cas. 350; Western Union Tel. Co. vs. Guernsey & S. Electric Light Co., 46 Mo. App. 120; Illinois Central R. Co. vs. City of Chicago, 141 Ill. 586, 30 N. E. 1044, 17 L. R. A. 530. In Illinois Cent. R. Co. vs. City of Chicago, supra, where a court of equity was asked to grant an injunction against interference with the operation of a railway at a street crossing, we said (page 603, 141 Ill., page 1048, 30 N. E., 17 L. R. A. 530): 'It is well understood that the track or right of way cannot, in the nature of things, be restored to the same state of usefulness with the street thereon as before. It is to be restored so as not to impair its usefulness more than is necessary in view of its use for the purposes of a street, subject to the use by the railroad company. It is not to be rendered less useful, except in so far as diminished safety and convenience are separable from its use by

the public as a street crossing. It is not expected that the crossing can be so restored as to obviate all danger, or delay, or inconvenience. It is only necessary that there should be no unreasonable impairment of the usefulness of the railroad right-of-way.'

"One of the interferences with appellant's system of telephone which is charged against appellee is that in many of the streets of the city appellee has erected its telephone poles and strung its telephone wires upon the same side of the street where the telephone poles and wires of appellant are set and strung, and that appellee has been guilty of overbuilding the poles and wires and telephone system of appellant; that is to say, that it has strung its wires above the telephone wires of appellant, instead of stringing them below the same. In other words, appellee is charged by appellant with 'overbuilding' and 'paralleling,' as the terms are used by the expert witnesses. If the city has no right to grant the exclusive use of the street to one telephone company, and has the right to grant the use thereof to two or more telephone companies, then the right of a later telephone company, coming into the street, to place its telephone lines upon the same side of the street with the telephone company coming earlier therein, necessarily results as a matter of course. There are only two sides to each street, and, if there are more than two telephone companies, two of them must necessarily be on the same side of the street. If one telephone company has no right to the exclusive use of the street, it has no right to the exclusive use of one side of the street. In the case at bar the evidence shows that on many of the principal residence streets in the city appellant has its poles and wires set and strung upon both sides of the street. Necessarily, therefore, in such cases the appellee was obliged to be, for a part of the route at any rate, upon the same side of the street with appellant. In the case already referred to of Louisville Home Tel. Co. vs. Cumberland Telegraph & Telephone Co., supra, it appeared that the second company placed its line of poles and wires on the same side of the street occupied by the first company, and this was there held to be no substantial interference with the rights of the first company. The right of the appellee to be upon the same side of the street with the appellant is substantially conceded by appellant in its bill, because it therein avers that 'it was and is the duty of said Northwestern Telephone Company to so construct its lines as not to unnecessarily interfere with the system and lines of your orator; that it was and is the duty of said defendant company in the construction of its lines, in cases where it is absolutely necessary to cross or parallel the lines of your orator, to underbuild the lines of your orator.' This allegation is, in effect, an admission that, where it is absolutely necessary, appellee can parallel appellant's lines of wires; that is, can be upon the same side of the street with appellant.

"Appellant, in addition to the contention that appellee should not be upon the same side of the street with it, contends that it should not overbuild appellant's telephone system; that is, that it should not, by the use of higher poles than those of appellant, string its wires above those of appellant. Appellant contends that appellee should underbuild, instead of overbuilding; that is, should string its wires under those of appellant, instead of stringing them over those of appellant. The testimony shows that there are in the streets of Aurora some nine companies or interests making use of the streets for the purpose of erecting poles and stringing wires, to wit, appellant and appellee, the city arc light system, the city fire alarm system, the city police alarm system, the Western Union Telegraph Company, the Postal Telegraph Company, the Aurora Electric Light & Power Company, and the street railway company. The wires of the Aurora Street Railway, the Aurora Electric Light & Power Company, and the Aurora Electric Lights carry high potential currents of electricity, while the wires of the telegraph companies, of the city police alarm and city fire alarm, and the wires both of appellant and appellee carry low potential currents of electricity. The proof shows that in the proper construction of overhead systems of wires the different high potential systems of wires should be placed on one side of the street by themselves, and the different low potential systems of wires should be placed on the other side of the street by themselves. The reason of this is, as stated by the different experts, that, if the wires of the high potential system drop and come in contact with the wires of a low potential system, the high potential current of electricity is thus conveyed from the high potential wires into the wires of the low potential system, and damage and injury to life and property are liable to follow such a contact. But if a wire conveying a low potential current of electricity drops down upon another wire conveying a low potential current of electricity, no harm is ordinarily done, except that the two wires, forming a contact, disarrange the service of each until the two wires are separated. Thus, if a wire of one telephone system drops upon a wire of another telephone system, the telephones along the lines of each of these two wires will not work properly until the wires are separated. So, on the other hand, if a wire conveying a high potential current of electricity drops upon another wire conveying a high potential current of electricity, no particular harm is ordinarily done further than perhaps the burning of a fuse, or something of that kind. Inasmuch as the wires both of appellant and of appellee convey low potential currents of electricity, the dropping of the wire of one upon the other would do no particular harm. The evidence shows that in many instances, and on many streets, appellee overbuilt appellant's system, or strung its wires above those of appellant on the same side of the street with the appellant because if it had crossed the street with its wires and strung them on the opposite side of the street, it would have been obliged to string them above wires conveying high potential currents of electricity. This would lead to the risk and dangers necessarily arising from the falling of a wire conveying a low potential current of electricity upon a wire conveying a high potential current of electricity.

"Appellant complains that one of the dangers resulting from the overbuilding of its wires by the wires of appellee is that some wire of appellee is liable to break and fall down and come in contact with the appellant's wires; but, as we understand the evidence, such contact between the wires of appellee and appellant, both being wires of a low potential system, would be harmless, unless the same wire of appellee, at some other point in the city, should break and form a contact with a high potential wire, thus conveying the high potential current of electricity through the wire of appellee into the wire of appellant. In other words, one of appellee's wires must first come in contact with a high potential current of electricity at some place in the city, and, while that contact continues, the same wire of appellee must fall, and come in contact with some wire of appellant at a point where appellee's wires overbuild those of appellant. Thus, in order to produce the danger anticipated by appellant from the contact in question, two accidents must happen—one, that at some place in the city appellee's wire breaks and comes in contact with a high potential current; and, second, that, when appellee's wire is so charged with such high potential current, it will break and fall upon the wire of appellant where it overbuilds the latter. The probability of these two accidents happening at the same time is too remote and uncertain to jutsify the issuance of an injunction against such overbuilding by appellee."

I consider each number of TELEPHONY worth its weight in gold. J. A. DUNCAN.

Fort Wayne, Ind.

Telephony.

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THE BERLINER DECISION.

The United States Circuit Court of Appeals has decided the now famous Berliner patent case in favor of the defendants, the decision being a sweeping Independent victory, which was handed down at Boston January 16, 1903, and is so clear on every point that even if an appeal were possible the American Bell Telephone Company would have absolutely no grounds for action. There was little doubt as to the outcome of this suit in the minds of those who have followed the case closely. The Independents have had very little fear as to what the decision would be, and it would seem as though the Bell Company had carried the case to the final court purely for the purpose of intimidation.

The following letter from Hon. James M. Thomas, president of the Independent Telephone Association of the United States of America, is pertinent:

New York, January 19, 1903.

Editor TELEPHONY, Chicago, Ill.:

Dear Sir—I am to-day in receipt of a letter from Mr. Edward P. Payson, counsel for the defendants in the Berliner case, which has lately been decided at Boston. As I know you will be anxious to have his interpretation of our great victory in the Court of Appeals, I herewith give the same:

"The second defense, namely the insufficiency of the Berliner application, is not specifically passed upon. The fifth defense, double patenting, is not alluded to.

"The fact that the Bell mercury transmitter operated by variations of pressure is affirmed, but the apparatus is not held to have been sufficiently practical to be an anticipation.

"The third (Edison) defense is affirmed as to Edison's 1877 discovery and his April 1st apparatus; and his carbon electrode, which, in the fall of 1877, 'represents the first marked advance in the transmitter art since the 1876 Bell patent,' and the carbon electrode is found in every commercial battery transmitter; and in the value of the work of Prof. Hughes with reference to the variations of resistance at a loose or feeble contact between solid electrodes in constant contact is considered at length.

"You will see, therefore, that the defense upon which the opinion mainly rests is the fourth defense, and namely, that Berliner really contributed nothing to the art of telephony; that his rights are purely technical; and that the defendants' transmitters contain nothing derived from Berliner and are not within or an infringement of his patent, even if the patent be valid; as to which defense, at page 238 of the brief, we said that even if Berliner tried his metal electrodes before Mr. Edison invented carbon, considering that carbon was not implicit in Mr. Berliner's work, but was produced by Edison, 'the Berliner patent in suit must be given a narrow scope so limited as not to include either form of the defendants' transmitters.' It is submitted that this view presented under the fourth defense is in every respect a conservative view of the premises; that it leaves to Mr. Berliner the very utmost that can be reasonably claimed for him; that it concedes to Mr. Edison only that of which he was evidently the discoverer and the inventor," etc.

So that you can see that we have gained in this court all that was hoped to be gained, in having them affirm the decision of Judge Brown in this way, and it leaves nothing of the Berliner invention of any practical commercial value, as all the commercial telephones used throughout the world have carbon electrodes.

The following extract from the opinion of the Circuit Court of Appeals should definitely set at rest the report of the Boston papers that the Bell company had won its suit, and which has been copied in many of the western papers:

"We find that in the fall of 1877, Edison discovered the carbon electrode; that this discovery represents the first marked advance in the transmitter art since the 1876 Bell patent; and that the carbon electrode is found in every commercial battery transmitter.

"We find that in May, 1878, Prof. Hughes discovered microphonic action, or the fact that sound-waves produce remarkable variations of resistance at a loose or feeble contact between solid electrodes in constant contact whereby speech may be transmitted; that the principle he then made known is utilized in every practical battery transmitter; and that he embodied his discovery in an instrument which he was the first to term a microphone.

"We also find that Edison's discovery of the carbon electrode and Hughes' discovery of microphonic action solved the problem of variable-resistance transmitter, whereby speech may be transmitted long distances; and that both these discoveries are embodied in the defendants' transmitters.

"We also find that the two claims of the Berliner patent in suit, although upon their face open to the objection of excessive breadth, may be sustained when read in connection with the specification,

provided they are limited to metallic electrodes, and that when so limited, the defendants' transmitters do not infringe.

"OUR CONCLUSION IS THAT THE DECREE OF THE CIRCUIT COURT MUST BE AFFIRMED ON THE GROUND OF NON-INFRINGEMENT."

I think this matter is of enough importance to your valuable magazine to give a complete history and the final results of this great litigation.

After the decision in the Government case in which the Supreme Court sustained the decision of the Court of Appeals, refusing to cancel the Berliner patent on the grounds of fraud and other claims contained in the bill of the Government, nothing remained to be done but for those interested, outside of the American Bell Telephone Company and licensees, who had invested their money, but to bend their efforts towards the defeat of the Berliner patent, so far as it related to what is known as the carbon microphone. Immediately after the organization of the Independent Telephone Association of the United States of America at Detroit, in 1897, a committee was appointed consisting of Hon. H. D. Critchfield, of Chicago, formerly of Ohio, Judge Savage of Pennsylvania and myself, who undertook to assist the defense in three cases brought by the American Bell Telephone Company in the city of Boston. The National Telephone Manufacturing Company, which has been the prominent party in all this litigation, had previous to this time retained Mr. Edward P. Payson, of Boston, as its counsel, and arrangements were effected whereby the three cases (on account of involving the same issues) were to be considered as one, and that Judge R. S. Taylor, of Fort Wayne, Indiana, should be accepted as a representative of an outside interest to assist in trying this case.

Only those who have been through similar experiences can appreciate the amount of work that was expended in preparation of the defense and in financing a plan whereby this great victory has been brought to the Independent telephone interests of the United States.

Mr. Edward P. Payson has devoted years of study to the troublesome legal and technical questions involved in this case. He has worked faithfully and deserves the gratitude of all the investors of the $200,000,000 which was jeopardized in this case. This being the amount that is now invested in Independent telephony.

Judge R. S. Taylor, having been on the Government case, and being more or less familiar with the questions involved, immediately took up the work and has proven a master in the handling of legal and technical questions involved therein.

No case ever had more devoted lawyers, and the courts have had no case involving greater and more universal interests than this famous Berliner case.

The Litigation Committee of the Association, consisting of Hon. Hugh Dougherty, Bluffton, Ind.; Hon. H. D. Critchfield, Chicago; Hon. S. P. Sheerin, Indianapolis; E. B. Fisher, of Grand Rapids, Mich., and myself, have worked and contributed in every way possible to the support of those who had undertaken the defeat of this patent.

Yours very truly,
JAMES M. THOMAS.

The decision in full is given in this issue of TELEPHONY, and should be carefully read. The Bell defeat is complete and there will be no more patent litigation. The thanks of every Independent should be given to the telephone manufacturers, who furnished the funds with which to fight this suit, the National Association and the able counsel for the defense.

A DISAGREEABLE FEATURE OF TOO RAPID GROWTH.

An excessive and unexpected growth in the number of local subscribers to a telephone exchange may develop into a detrimental lessening in value of the property as a whole when the increase in the number of subscribers has reached a point where it is economy to rearrange and replace all outside wire circuits, to set heavier poles, to replace small with large cables, to move the exchange into more commodious quarters, or to establish the main exchange nearer the telephone center of the section supplied. Of the outlay required to make these replacements, as much as does not increase the earning power of the plant is properly chargeable to depreciation, or to the fund set aside for deferred maintenance.

Strange as it may seem, it has appeared almost impossible to accurately anticipate the marvelous growth in the number of telephone subscribers so noticeable during the past five years. Ten years ago, telephone engineers planned their exchanges to supply service to a maximum number of subscribers equivalent to one subscriber to thirty of population. Later, the ultimate capacity of exchanges was based on a list of subscribers equal to one-twentieth of the population. Then, in 1899, it was agreed that it was unwise and uneconomical to design telephone plants having an ultimate capacity throughout of less than one-tenth the population of the city and its suburban towns. That is, if the number of inhabitants in the given territory was 600,000, then ample provision should be made for 60,000 subscribers. But now the thoughtful telephone engineer shows his board of directors how much more prudent it is to base the estimate of ultimate capacity of the plant on the number of families in a city, or in the ratio of one to six.

That is one reason why it is a common saying among telephone men that the capital account of a telephone company is never closed, for the construction work is never completed. And in this constantly increasing volume of business lies one of the dangers that menace investments in telephone exchanges. Many a telephone company has had to increase its investment not only once, but twice, thrice, or even four times within the short space of five years; a condition of affairs very satisfactory when the profits are secure, but very unsatisfactory when there is a continuing and increasing loss. For although these companies were supposed to have attained their growth, yet they have doubled and trebled their list of subscribers, and even conduit systems which were considered sufficient for the growth of many years had to be doubled and trebled in some cities. Ten years ago conservative telephone engineers thought it unwise to place more than 50 pairs of wires in one cable; five years ago 200 pairs were thought sufficient; and two years ago orders were placed for cables containing 800 wires, or 400 pairs. Five years ago there were only 22,000 telephone subscribers in New York City; to-day there are more than 88,000; and there is no competing company in New York. In Chicago, the net growth for the year 1901 in the number of telephones installed exceeded the number in operation at the beginning of the year 1898, and the increase for the year 1902 has been 33,000. The total number of instruments in use by the Chicago Telephone Company is in excess of 80,000.

OKLAHOMA INDEPENDENT TELEPHONE ASSOCIATION—ORGANIZED AT GRANITE, O. T.

On Monday, January 12, 1903, the Independent telephone companies of Oklahoma, met at Granite, O. T., and organized the Oklahoma Independent Telephone Association. Owing to it being poorly advertised only a few companies were represented, but feeling that a start was necessary to accomplish any great undertaking, and knowing that we had the good will of every Independent man in the Territory, organization was perfected. Geo. W. Patterson was elected chairman and Chas. E. Davis, secretary. The Oklahoma Independent Telephone Association was selected as the name for the organization. Chas. E. Davis and Mr. Rutherford, Jr., were chosen as a committee to draft by-laws, and were instructed to report at the next regular meeting to be held at El Reno, O. T., February 24, 1903. Every Independent company in the Territory is urged to have a representative present at this meeting. Those present were: Wright, of Mangum; Tally and Jones of Granite; Wildman, of Blair; Rutherford, of Hobart; Patterson, of Elk City, and Davis, of Weatherford.

KANSAS INDEPENDENT TELEPHONE CONVENTION

The annual meeting of the Kansas Independent Telephone association was held at Topeka, Kansas, on January 28 and 29. A complete report of this convention will appear in the March TELEPHONY.

Reminiscenses of Early Telephone Troubles

By C. O. HARRIS, of Rochester, N. Y.

Everybody has his troubles, and the telephone man is no exception to the rule. But telephone troubles are so varied in character that their arrival adds a certain attractiveness to them and each case adds to that storehouse of knowledge that makes the work of the telephone man comparatively easy to him who understands telephony in all its varied branches.

Telephone troubles have existed ever since the advent of that useful servant of the commercial and social world. In the early days of the installation of the telephone there were troubles that the public, nor even the telephone man of today, ever realized. Any one who remembers the clumsy and crude telephone apparatus of the year 1877, '78, '79 and '80 will readily admit that a very great improvement has been made in everything that goes to make up a successfully operated telephone exchange in the twenty-six years that the telephone has been in use, and the end has not been reached by any means.

The first telephones installed in Rochester were sent here in the fall of 1877, and were connected up by the late B. F. Blackall, then superintendent of the fire alarm. I was employed by him at that time in the extension of the fire alarm system and naturally helped him construct the telephone lines, without, I confess, knowing at the time very much as to just what I was doing, or realizing for a moment what the growth of the telephone business would be in the next twenty-six years. One of the lines ran from the Cunningham Carriage factory on Canal street, to Mr. Dryer's residence on Alexander street; one line from Pratt & Weed's (now the Westcott Express Company's office) in the Arcade to the old depot on Mill street; a line from the Rochester Brewing Company and a few others that I have forgotten. There were no poles to speak of in those days in Rochester streets; everybody seemed to prefer using the buildings, and, strange to say, there were very few, if any, objections offered to wires being placed on roofs. True, there were comparatively few wires at that time.

When the instruments were unpacked they were the admiration of the hundreds of people who saw them, and when screwed to the wall and connected up and we talked over them, they excited considerable wonder on the part of the public. They were what is known as magneto sets; that is, each set consisted of a magneto generator mounted in a box about eight inches wide and about two and one-half feet long. To ring the bell at the other end of the line you would turn the crank, which projected through the front of the box and the current thus generated would cause the bell at the other end of the line to ring. There were no transmitters in those days; in fact not until about the year 1882. A wooden case receiver was the talking part of the set. You kept it traveling back and forth between your lips and your ear, and that part of the conversation you lost, you imagined. After a while some genius discovered that two receivers connected in multiple worked the same, which facilitated matters a little, as you could hold one to your lips and the other to your ear. They talked well, considering; but there were no disturbing influences in those days; no electric light or trolley currents, no other telephone wires to gather cross-talk from.

Our troubles under such adverse circumstances, you can easily imagine were frequent. The lines being single, with a ground return, it needed but the touching of the line to a tin roof to put an effective stop-gap on the line between the stations and prevent the current from passing. The apparatus was crude and did not have that range of adjustment that the present telephone apparatus has, but by the exercise of considerable ingenuity we managed to keep it working with fairly good success.

With the construction of the telephone exchange in 1878, we all thought we had reached perfection in the matter of apparatus. We had at that time, but when we all look back and review the past, how crude it all seems. All the lines were built and operated upon a series-grounded system; that is, the line was taken in and out at each subscriber's house and closed through the ground at the then last subscriber. When another was added farther on, the ground wires were removed and the new man carried the end of the line. The lines were all operated on a closed battery circuit; that is, the line was operated by a battery at the exchange, which was kept on the line at all times. Each instrument consisted of a single stroke bell, mounted on a wooden box which contained a switch-hook which could be thrown to the left or right according to which direction on the line you wished to talk, and a receiver which hung on the hook.

When you desired to call central you pressed the key or button twice as the call for central, three for the first subscriber, four for the next and so on, six subscribers being the limit. When central answered, which was indicated by the hammer of the bell falling back, you unhooked the receiver, threw the switch to the left and yelled; talking would be a misnomer. If central finally understood you, you got the connection. Had you been at the exchange you would have seen a long upright partition-like board upon the top of which was mounted at one time about 150 single stroke bells. Each line entering the exchange passed through its respective bell and terminated in a vertical brass strip running down the board. At the bottom of the board the vertical strip crossed a horizontal strip placed underneath; the connection between the two being made with a small plug; the horizontal strip being connected to the battery, the negative side of which was grounded. Boys were employed to watch the bells and when they rang twice he unplugged that line from the battery and connected it to another horizontal strip running along the board, which was wired over to a small table at which sat an operator. After plugging the line to say table A, he would tap on a key which rang a bell on table A, and she would plug in her receiver and endeavor to ascertain the name of the party wanted. If she secured it she would make out a slip showing the line she wanted and pass it up. The switchboy would plug that line on to the next strip of table A and the operator would call him and make the connection. There were no indicating devices in those days, and to prevent the subscriber from being tied up there were a number of boys of about 12 to 14 years of age employed, whose duty consisted of sitting on a high stool holding a receiver to their ear which was connected to the strip upon which the lines were connected. When the subscriber finished talking, he frantically and audibly notified the nearest switch-boy that "A-1" or "C-3," etc., was through. During the busy hours, with the ting-ting of the bells, the calling of operators for lines, the shouting of the ring-off boys, of the operators to the subscribers, one wonders how we ever succeeded in operating at all, but we did, and thought we were all right.

With the extension of the lines and the increase in the number of the telephones, the lot of the trouble man was

not a happy one. All being house-top lines, an extension ladder was a necessary part of the poor lineman's equipments. Edward C. Bradley, who looked after that part of the system, can relate some soul-stirring experiences encountered while chasing trouble on house-top lines, especially in the rear of the lots on the east side of Lake avenue. Those were heart-breaking times, and the position of the trouble man was one to be avoided.

In common with all men in the business at that time, there was very little known of the troubles that one might expect. Each case of trouble was something new, and you simply had to work out your own salvation. But then subscribers were more lenient that they are now, and it was a rare thing to run across one who complained.

I remember one subscriber in the winter of 1878 who was so solicitous of the employes that when he found his telephone out of order, he kindly unscrewed it from the wall and brought it to the office to be repaired. True, he forgot to connect the wires so that the lines would be closed and the rest of the subscribers on the line could get service, but it showed a kindly feeling on his part even if it did cause a man a trip out Main street to close the line.

The subscriber at that time, like the subscriber of to-day, seemed to expend his energy in trying to discover new places to hang the receiver, instead of where it is intended to go, on the hook. The only difference is, with the old system you disabled the whole line with its six subscribers; now you disable your own line.

Considerable has been written and told of the heart-breaking troubles encountered in the operation of the telephone, and what was true in the earlier days, is equally so in the present day. There are troubles at times that defy all the combined expert and theoretical knowledge of the best telephone engineering talent in the country to ferret out. Troubles as a whole have been reduced to a minimum, but there is not an exchange in the world, but has a certain percentage of trouble every day it is in operation.

The every day troubles of an exchange can be ascribed to various causes. First and foremost is the wind. No matter how well built your lines, on a windy day will bring you crosses and swings with an occasional limb of a tree thrown in to add to the confusion. Then comes the leaving off of receivers by subscribers either intentionally (to prevent their being called) or accidentally which keeps the signal in on the switchboard until the receiver is hung up. The careless, and in some cases reckless, manner in the handling of the instruments by the subscribers, the repairs of floors and walls and the frequent cutting of the wires, the neglect of the subscriber to speak into the instrument properly, and a number of imaginary troubles, which upon investigation prove to be groundless.

Every telephone company expects to have, and makes provision for the proper handling of the trouble as rapidly as it is discovered or reported to them, but frequently they are called upon to handle considerably more than for several previous days without any apparent cause for the increase. Is it to be wondered at that it frequently occurs that a telephone is out of service for several hours. In nearly every instance trouble is discovered and some one sent out on it hours before the subscriber himself finds it out. It may be that the trouble has been located by the trouble man and is of such a nature that it requires an entire gang of linemen to repair it. If such occurred it would not be repaired until the next morning.

Another source of exasperation is the practice of some subscribers have of reporting their telephone, then going away, locking up their house or office and thus preventing the trouble man from getting in. I know of an instance within the last few days where a trouble man went six times to an office in the city during business hours to repair the telephone, and found the office locked. At 6 o'clock the subscriber returned, found his telephone still in trouble and made a complaint. Men will order the plumber or gas fitter and will make provision for them to enter, as—for any provision for the telephone man, one never thinks of that.

Some subscribers can never be convinced that their complaint has been attended to unless they see the trouble man. The trouble on a line may be a mile from the subscriber and of such a nature that it can easily be repaired there; in fact there is no other trouble on the line and the repairing of it at that point removes the trouble, and the line tested, which is always done.

There is a right way and a wrong way to talk over a telephone. Seventy-five per cent choose the wrong way, and the man at the other end blames the telephone because he cannot hear well, and reports it. A man is sent, looks over the instrument, tests it and finds it O. K., but unless he spends several hours and pulls everything apart, that subscriber is firmly convinced that the man does not know his business.

Every telephone company, no matter how small it is or how large its list of subscribers may be, is just as anxious as the subscriber to have troubles removed. They realize that it is due every subscriber to keep his telephone working under all circumstances, and the average subscriber little knows the amount of time and expense incurred in keeping his telephone working under adverse circumstances. Do not jump on the poor trouble man when he calls to fix your telephone; he works ten or more, often twelve and fifteen hours each day; is getting around just as fast as the trolley cars, bicycle or horse will take him and is just as anxious as you are to get it fixed, and anything you can do to help him along will enable him to accomplish the result quicker.

Every telephone company with an exchange of any size maintains a system of general inspection, which is great preventive of trouble and keeps it down to a minimum. Like all electrical apparatus, telephones will not take care of themselves. With the hard usage, I might say rough usage, which they receive at the hands of some subscribers, they would develop all kinds of trouble if not inspected from time to time. And that is true of the instruments is true of every part of the plant. A constant inspection is made of the lines, their connection at cable poles and elsewhere that no possible loose connection might creep in, as loose connections are the trouble man's *bete noir.* A broken wire can be readily located and promptly repaired, but a loose connection will cause more trouble and take longer to find than any other class of trouble. In the old days the ordinary lineman spliced, or as an emergency, the bell hanger's joint would suffice, but those conditions would close an exchange up in a week with the present systems. Every connection has to be soldered and kept soldered. It takes an inspection to keep them soldered.

There are the times when even in exchanges of five or six thousand subscribers there will be no trouble for several hours; then the trouble men get their well earned rest and reward and indulge in day dreams of that time to come when such a thing as telephone troubles will be unknown, when everything will be serene and no wind, rain, snow or sleet will come to becloud the perfect horizon of such a heavenly existence.

NO BACKING OUT NOW.

It was a resolute voice that spoke through the telephone.

"Col. Bigmun," said the owner of the voice, "you know you proposed marriage to me last evening."

"Yes, Miss Quickstep."

"Well, I accept. . . . Central, are you listening?"

"Yes," replied the girl at the telephone exchange.

"That's all. Ring off."—Chicago Tribune.

MANUFACTURERS' SECTION

LEAKS IN TOLL REVENUE.

To those intimately connected with the rapid growth of the telephone business during the past few years, it is well known that no branch of the business has contributed more directly or more immediately to the increase of revenue and profit of the telephone company than the toll department.

It is also well known to telephone engineers and others who have made a study of the conditions pertaining to this branch of the service that it presents more opportunities for leaks of revenue than does the local contract service.

First—By reason of failure to collect from the consumer the full amount the company is entitled to receive, under its own rules, for service rendered.

Such service is ordinarily charged for on a basis of time elapsing during the conversation at some fixed rate per minute or per period of minutes for the distance covered.

CALCULAGRAPH, STYLE B.

CALCULAGRAPH ON PEDESTAL.

CALCULAGRAPH, STYLE A.

It has been, of necessity, the practice to require the operator handling the toll connection on the switchboard to calculate and record the time elapsing during each such conversation, thus fixing the charge for the service.

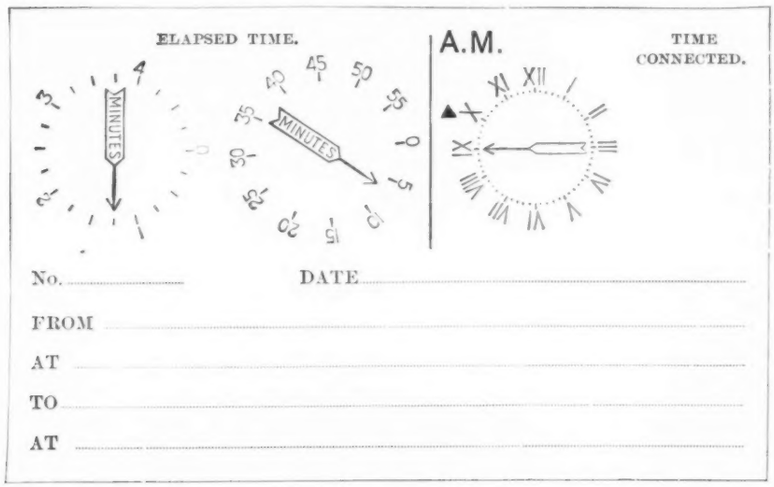
The tools employed were usually a pencil and a clock having a visible dial; the time-of-day being noted on a card when the conversation commenced and again when it was completed, the first record then substracted from the second to determine the elapsed time.

A long series of tests of toll records made under varying conditions in different exchanges and covering the work of a great number of operators have resulted in a showing that more than twenty per cent of the records of elapsed time so made contain errors exceeding one minute on each message and that over ninety per cent of such errors are made in favor of the patron.

In conducting such tests, inspectors using stop watches were employed. They then "listened in" on the line and made duplicate records for comparison. Having no other duties and being able to give his entire attention to timing a single message, the inspector's record, made with the aid of a stop watch was assumed to be correct, while the operator had other duties which required attention and frequently had to handle several connections at the same time. It was found physically impossible for her to time messages correctly by the means above described. In most cases the record of elapsed time so made is little better than a "guess" or an "estimate."

The most conscientious operator will give the patron the benefit of the doubt, and he is charged in a large number of cases for the minimum period of time prescribed by the rules.

Secondly—As an inevitable result, when both sending and receiving operators on a toll line estimate the time consumed in a customer's talk over the line, their records do not agree. Then follows a hold-up of the line while the two operators discuss the length of the last message. If they cannot agree the chief operator may be called in to arbitrate; meanwhile the line is producing no revenue for the stockholders and possibly some other patron who is waiting to use that line is impatiently abusing the slowness of the service.



CALCULAGRAPH RECORD.

To meet such conditions in the telephone toll service, the Calculagraph was devised, and as its function is to calculate and record by mechanical means the time, in minutes and quarter minutes, which elapse during a toll conversation, it definitely fixes the charge for the same and effectively stops a serious leak in the revenue of the telephone company employing it.

It makes no clerical errors. It is operated by pulling a lever, which can be accomplished without mental effort on

the part of the operator and while she is attending to the switching of some other line.

It is interesting to note the increase in the number of "overtime" messages in an exchange where a Calculagraph is installed, during the first month it is in use. In a busy exchange or one where long haul messages are handled, the increase in receipts from tolls due to such elimination of errors in timing, is sufficient to repay the cost of the Calculagraph in a short time.

Besides, the timing of messages at the receiving end of the line may be dispensed with and both operators are relieved of much mental and manual effort and their efficiency in the other duties of operating is correspondingly increased.

Thus by proving its usefulness and wholly on its merits, the Calculagraph, wherever introduced, has made itself indispensable.

Over one thousand telephone exchanges in the United States are now equipped with Calculagraphs, those in the larger cities using from fifty to seventy-five instruments each. They are also used in over two hundred towns and cities in Canada, in many of the larger cities in the German Empire, Japan, Australia and other foreign countries.

The Calculagraph is noiseless in its operation and may be mounted directly upon the switchboard or upon a pedestal standing on the floor alongside the operator.

Several types of the instrument are made by the Calculagraph Company, 9-11-13 Maiden Lane, New York City, who will furnish additional information upon request.

The Calculagraph Company owns United States patent No. 424,291, dated March 25th, 1890; United States patent No. 424,292, dated March 25th, 1890; United States patent No. 449,192, dated March 31st, 1891; United States patent No. 583,320, dated May 25th, 1897; United States patent No. 679,408, dated July 30th, 1901; United States patent No. 697,426, dated April 15th, 1902; United States patent No. 697,427, dated April 15th, 1902.

Said patents covering all forms of apparatus which will calculate and record elapsed time or the value of elapsed time.

Any such apparatus or instrument manufactured by others or offered for sale in the United States is claimed by the company to be an infringement of said patents, and its use by the purchaser would also infringe the rights of this company and will not be permitted.

The company also owns trade mark patent No. 21,747, dated August 22d, 1892, covering the use of the word Calculagraph.

TRADE NOTES

Raber & Watson, Old Colony Building, Chicago, Ill., dealers in cedar poles, are sending out a very attractive desk calendar.

The Electric Storage Battery Company, Philadelphia, Pa., has just completed the largest year's business in its history.

L. B. Allen Company, 234 Greenwich street, New York, will send upon request prices and descriptive matter pertaining to Allen's soldering salts and soldering paste.

The Atwater Kent Manufacturing Works, Philadelphia, manufacturer of the Monoplex telephone, is sending to the trade a very attractive calendar embellished with a pen and ink sketch of a Gibson girl. This calendar will be sent prepaid to any part of the world upon request. The company reports a large increase in sales and has placed on the market a complete system of intercommunicating telephones.

The Calculagraph Company, New York, announce it has recently received an order from a prominent operating telephone company for one hundred and forty calculagraphs.

The Stromberg-Carlson Telephone Manufacturing Company, Chicago and Rochester, has recently closed contracts for exchange equipment at Roudd, Ia., and Shawham, Ky.

The Yonker's Specialty Company, Yonkers, N. Y., has just issued a little leaflet on the Metropolitan cable clip for supporting aerial cables, which will be sent postpaid upon request.

The Nernst Lamp Company, Pittsburg, is sending out a leaflet on Nernst lamps entitled "More light less money." The company requests that prospective buyers send for its catalogue number 2.

The Chicago Pay Station Company, Chicago, has ready for distribution a circular describing Chicago pay stations and the Baird battery guage which will be sent postpaid upon request.

The India Rubber and Gutta Percha Insulating Company, Yonkers, N. Y., manufacturer of "Habirshaw" wires and cables, has secured several large contracts for wiring and construction.

Johnson & Morton, Utica, N. Y., has just issued pamphlet 1008 which illustrates and describes the J. & M. panel boards and accessories. The pamphlet is very complete and will be sent free upon request.

The Central Electric Company, Chicago, has just issued a new discount sheet and price list which goes into effect February 1, 1903, and is very complete. It will be sent to any one interested upon request.

National-Acme Manufacturing Company, Cleveland, Ohio, announce that Mr. W. S. Chase, formerly treasurer of the Cleveland Machine Screw Company, has accepted the position of sales manager of the company.

The McDermid Manufacturing Company, Chicago, reports an increased demand for magnet wire and is running its factory to its full capacity. The company makes a specialty of magnet wire, cords and ringers.

The Folding Cabinet Company, Lancaster, Pa., is sending to the trade illustrated descriptive matter on the Attick folding telephone cabinet, which is claimed to be meeting with approval from telephone exchanges.

The American Electrical Works, Phillipsdale, R. I., manufacturer of bare and insulated electric wires and galvanized iron wire and strands, is distributing a calendar embellished with a miniature of Sir Humphry Davy.

W. J. Barr, Cleveland, Ohio, manufacturer of telephone arms, has just issued a very handsome booklet illustrating the Barr central energy cabinet which is claimed to be meeting with marked favor. The booklet will be sent upon request.

The Eureka Electric Company, Chicago, has just closed a contract with the Wagoner Telephone Company of

Wagoner, I. T., for a six hundred line trunking switchboard system with automatic signals and local talking signals and local talking circuit. This will be one of the most complete and largest installations in the Indian Territory.

THE MANHATTAN ELECTRICAL SUPPLY COMPANY, New York and Chicago, is mailing its latest trade price list applying to catalogue No. 24. The price contained in the list went into effect Dec. 10, 1902, and supersedes all previous quotations.

THE VOUGHT-BERGER COMPANY, La Crosse, Wis., has ready for distribution a set of leaflets illustrating and describing the company's complete line of telephone apparatus. These leaflets, seventeen in all, will be mailed free upon request.

THE CHICAGO LUMBER & COAL COMPANY, Minneapolis, Minn., dealer in cedar poles, is in position to promptly fill orders for all sizes of cedar poles. The company has yards at St. Ignace, Mich.; Blackduck and St. Paul, Minn., and Sand Point, Idaho.

THE D. M. STEWARD MANUFACTURING COMPANY, New York city, has moved its office from 107 Chambers street to 8 Jay street. The company will continue the manufacture of its specialties and reports a continually increasing demand for "Lavite" and lava electric insulators.

THE HOLTZER-CABOT ELECTRIC COMPANY, Brookline, Mass., and Chicago, illustrates a fine line of dynamotors and motor-generators in bulletin No. 139. These are for plating, charging, ringing and testing currents. This bulletin will be sent to any one interested upon request.

THE KELLOGG SWITCHBOARD & SUPPLY COMPANY, Chicago, announce that it has closed a contract for the installation of a telephone system in the Alexander Hotel, Honolulu, Hawaii. The system will comprise two hundred and sixty common battery telephones and a lamp signal switchboard.

THE MAGNET WIRE COMPANY, 141 Broadway, New York city, manufacturer of all sizes of magnet, weatherproof, annunciator, office, rubber covered, trolley and bare wires, carries in stock large quantities. The company is able to make prompt shipments, and is doing a remarkable amount of business.

THE EUREKA ELECTRIC COMPANY, Chicago, has just issued some attractive circulars describing the Eureka transmitter and giving six reasons why it should be used. The company is also issuing cards illustrating its entire line of apparatus in colors, which are very attractive and will be sent free for the asking.

THE CHICAGO TELEPHONE SUPPLY COMPANY, Elkhart, Indiana, has just issued a folder illustrating and describing the Chicago 1903 long-distance solid back transmitter, which is guaranteed for six years. The company reports a heavy demand for this transmitter and claims it is superior to anything offered the Independent buyer.

THE ELECTRIC APPLIANCE COMPANY, Chicago, Ill., announces that its telephone department has been improving its celebrated Noxem receiver until it can be claimed to be a perfect receiver. No telephone specialty which the company has yet placed on the market has met with the success which has been achieved by the Noxem receiver.

THE W. T. NAGEL ELECTRIC COMPANY, Toledo, Ohio, is sending out an estimate blank which is meeting with much favor. It is invaluable to telephone companies who are building or rebuilding their plants. It gives a complete list of material required in the erection of an exchange. The company also has ready for distribution bulletins numbers 2, 3 and 5, which will be mailed upon application.

THE AMERICAN CONDUIT COMPANY, Philadelphia, Pa., announce it will conduct the business of the Electrolysis-Proff Conduit Company. Mr. W. F. McCarthy will continue as manager of the Chicago branch. The American company manufactures bitumenized fiber conduit for underground electric distribution, and has just issued a book on "What a Conduit Should Be," which will be mailed postpaid upon request.

NATIONAL CONDUIT AND CABLE COMPANY, New York, has just sent to the trade the latest issue of "Copper Gossip," a sheet of practical information of the general business outlook, copper prices, the London copper market, copper mining development, European copper market and a report of the United States production and exports of copper. The last issue is of date January 21, and will be mailed free upon request.

THE NATIONAL ELECTRICAL SUPPLY COMPANY, Washington, D. C., has issued bulletins from one to seven illustrating and describing the Sumter "Bulls Eye" express switchboard, Sumterphones, Intercommunicating telephones, telephone accessories, construction tools, line material and telephone supplies. The bulletins are well printed and contain numerous illustrations. The entire set of seven will be sent free to any address upon request.

THE ST. LOUIS ELECTRICAL SUPPLY COMPANY, St. Louis, Mo., in a communication to this publication, says:

"We beg to thank you for your card calling attention to item contained in your last issue. This item is incorrect to a certain extent, for the reason that we have been favored with all of the electrical contracts of the World's Fair, amounting in all to five contracts, aggregating over $100,000. Thus far we have made shipment of over 27 carloads."

THE CHICAGO PAY STATION CO. is about to place on the market a time stamp for the purpose of timing toll messages. This time stamp would be of great value to telephone companies handling toll messages for the reason that it would enable them to charge the patron for the actual time of service rendered. An electrotype of the blank toll ticket used in connection with time stamp will be furnished gratis to all customers, enabling companies to have a first-class uniform system for this purpose. For further information regarding this device, watch the advertisements of this paper during the next few issues or address the Chicago Pay Station Co., 126 La Salle avenue, Chicago, Ill.

THE STANDARD VITRIFIED CONDUIT COMPANY, 39 and 41 Cortlandt street, New York city, is meeting with great success throughout the country in placing orders for its multiple duct conduit with patented steel key connection. This construction of conduit has received the universal endorsement of many of the largest corporations in the electrical trade. The company states that it is now working on contracts for some of the largest propositions in hand to-day, and the advantages which it has for prompt shipment have enabled it to book many large orders for export for underground work. This company's factories are among the largest in the world devoted entirely to the manufacture of all styles of multiple and single-duct conduit. The Bell Telephone Company and many of the large Independent telephone interests have placed orders with the company. The company is about to issue a very complete illustrated catalogue, and states that it is in a position to supply sufficient conduit to meet the entire demands of the United States.

THE VOUGHT-BERGER COMPANY FACTORY, LA CROSSE, WIS.

The Vought-Berger Company is one of the rapidly increasing telephone manufacturing plants, it being but a comparatively short time since it started business with a small shop and little machinery. Among its most valuable assets at the outset were the patents on the pendent telephone and the two balls adjuster, and for the first months all the time was devoted to the manufacture of these two devices, M. I. Vought and M. I. Berger being in charge of both the office management and the shop work. In January of last year, C. A. Sterling, a prominent business man of the northwest, bought out Mr. Vought's interest; and for lack of room, the shop, now assuming larger proportions, was forced into more roomy quarters.

Up to April, or for the first year of its existence, the company had carried on its business only through the mails, and by circularizing, yet it grew beyond all expectations, and new machinery and more men were constantly required, the increase being so rapid that the company bought the plant in North La Crosse, formerly occupied by the American Can Company, retaining the smaller building for a store and ware house. They have not confined themselves to the manufacture of their two original articles, but are making a large and varied line of wall and desk telephones, switchboards of every type, and of pole and fuse protectors. Their factory is completely equipped in every way, and they have a well planned wood-working department. Every department is under the direction of competent foremen, long experienced in the manufacturing of telephone equipments. D. T. Foley, for many years well known in electrical fields, is superintendent and purchasing agent, and W. D. Campbell, a well-known electrical engineer, is in charge of the engineering and experimental departments.

Among switchboards and complete equipments sold the last few months are: Jackson Telephone Company, Jackson, Minnesota for both Jackson and Alpha, Shakopee Telephone Company, Shakopee, Minnesota; Amundson Telephone Company, Esdaile, Wisconsin; Smithville Telephone Company, Smithville, Texas; Western Wisconsin Telephone Company, Arcadia, Wisconsin; Kiester Telephone Company, for Keister, Thompson and Frost, Minnesota; Alexander Telephone Company, Alexander, Iowa; La Crosse Telephone Company (toll board); Peoples Telephone Company, Houston, Minnesota; Redwood County Rural Telephone Company, Redwood Falls, Minnesota; for both Wabasso and Morgan; Walnut Grove Telephone Association, Walnut Grove, Minnesota; B. M. & R. Telephone Company, Wellston, Oklahoma; and the Dwelle Telephone Company, Lake City, Minnesota, for Grieves, Minnesota.

The Vought-Berger Company has equipped with interior telephone systems many large manufacturing plants. The Champion Coated Paper Mills of Hamilton, Ohio, the largest paper mill in the world, is using a system of twenty magneto telephones equipped with plug boxes. The Mankato Mills Company, Mankota, Minnesota, has also a Vought-Berger system; the Dime Deposit and Savings Bank, Scranton, Pennsylvania, a central battery system; the La Crosse Plow Company, La Crosse, Wisconsin, a switchboard and twenty telephones the American Blower Company, Detroit, Michigan, has an intercommunicating switchboard system.

FACTORY AND GENERAL OFFICES THE VOUGHT-BERGER COMPANY, LA CROSSE, WIS.

Among those interested in the company are: W. W. Cargill, president, who has grain and coal interests in the west; Henry Gund, vice-president, who is head of the Gund Brewing Company, and a man of varied business interests. These gentlemen, with M. I. Berger, secretary and treasurer, C. A. Sterling, general manager, and Mills Tourtellotte, form the board of directors. Mr. Tourtellotte is connected with various interurban electric railways, and

THE VOUGHT-BERGER COMPANY, LA CROSSE, WIS.

General Office.
Stenographic Department.
Superintendent's Office.
Engineering Department.

Accounting Department.
General Manager's Office.
Shipping Department.

THE VOUGHT-BERGER COMPANY, LA CROSSE, WIS.

Section of Plating Department.
Section of Wood Working Department.
Pendent Telephone Department.
Wood Finishing Department.
Section of Wood Working Department.
View in Wood Working Department.
Section of Buffing Department.

THE VOUGHT-BERGER COMPANY, LA CROSSE, WIS.

Cable Forming Department.
Telephone Assembling Room.
Terminal and Protector Department.
Switchboard Assembling Room.
Testing Department.
Section of Transmitter Department.
Spring Jack Department.

THE VOUGHT-BERGER COMPANY, LA CROSSE, WIS.

Die Makers' Room. Section of Machine Room.
Section of Stock Room. Section of Machine Room. Section of Stock Room.
Two-Balls Adjuster Room. Engine Room.

is also an attorney, prominent in the state. The stockholders are all men experienced and well known in financial affairs.

M. I. Berger, secretary and treasurer of the Vought-Berger Company, was born in Holyoke, Massachusetts, in 1877. His family, however, moved to La Crosse early the following year, thus making him a true westerner. His early education was in the La Crosse public schools, but in later years he attended the Ohio Military Institute at College Hill for his preparatory work. Between this time and his entrance into college, he was instructor of physical culture in an academic school in Chicago. He took the classical course at the University of Chicago.

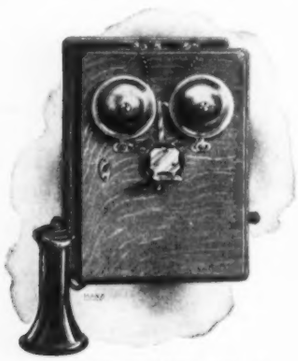
After a few years in a mercantile business, he met M. I. Vought and bought a half interest in his two patents. Upon starting in the electrical field he began with the very rudiments of the work, and devoted himself to that, until thoroughly familiar with the mechanical and electrical make-up of the apparatus the company was manufacturing.

When early in January Mr. Sterling bought part of the stock, Mr. Berger gave his entire attention to the office management and sales department, the business increasing under his management, and now is of such a nature that the general office management and superintendence require his entire attention.

THE G. D. EXTENSION CLOSER

A new model telephone extension closer for ringing a battery call bell is illustrated in cuts herewith, No. 4 showing the simplicity of the device and No. 3 showing it attached to the ordinary telephone magneto.

The device is mounted on an electrose base, the metal parts being nickeled. A radical departure is made in employing the movement of the bell clapper, instead of the usual magnets, to release the drop shutter. There is a small



CIRCUIT CLOSER NO. 3.

CIRCUIT CLOSER NO. 4.

switch provided, shown at the bottom of Cut No. 4, which may be used to open the extension circuit so that the extension bell will not ring when the shutter falls.

It is meeting with a large sale, induced partly by the low price and partly by the simplicity of the device.

It is known as the G-D. Extension Closer, and is being manufactured by the Garton-Daniels Company of Keokuk, Iowa.

ORDER DIRECT FROM FACTORY.

The Western Telephone Manufacturing Company wishes to notify the Independent telephone public that it is not selling its apparatus through agents, but prefers to have all orders sent direct to its offices, 1005 Monadnock Block, Chicago, or its factory, Winthrop Harbor, Illinois, where buyers can be sure of securing the company's latest improved product. The company has recently placed on the market a new circuit changer or cam-lever ringing and listening key, which is probably the most important functional part of the switchboard. This latest device of the Western is simple, effective and durable. The key uses only eight springs mounted on a cast brass base so that the whole structure only occupies a space of ¾"x¾"x2", while the cam-lever plate on top of table is a simple nickel globe ½" in diameter. The platinum contact springs are set in a block of hard rubber.

A PROMINENT MANUFACTURER.

Henry Teideman, secretary of the Menominee Electric Manufacturing Company, Menominee, Michigan, is one of the well-known men in the telephone manufacturing field, he having been engaged in electric and telephone manufacturing for the past twenty years, founding the Menominee company about eleven years ago. His honesty, straightforwardness and kindness of heart have made him many friends. These attributes with his well-known mechanical and electrical ability, combined with close application to business have been the marked factors in placing the Menominee company in its present prominent position. Few of Mr. Teideman's friends know that he was an officer in the German army and comes from one of the old families of the Fatherland. When he came to this country and became an American citizen he discarded a title and a high position

HENRY TIDEMAN.

in the army. The portrait shows him as a German officer and was taken some years ago. Associated with Mr. Teideman are Messrs. Geo. B. Harmon, A. D. Gibbs and H. S. Harmon, president, vice-president and treasurer respectively of the Menominee Electric Manufacturing Company. These men, like Mr. Teideman, are all prominent with large interests, and wide business experience. It goes without saying that the future of this prominent company should be very bright and Mr. Teideman and his associates are now reaping the benefit of their years of work.